

Sustaining and Enhancing the Research Mission of Public Universities

*Merrill Series on
The Research Mission of Public Universities*

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Introduction

Mabel Rice

The Fred and Virginia Merrill Distinguished Professor of Advanced Studies and Director, Merrill Advanced Studies Center, The University of Kansas

The following papers each address an aspect of the subject of the fourteenth annual research policy retreat hosted by the Merrill Center: *Sustaining and Enhancing the Research Mission of Public Universities*. We are pleased to continue this program that brings together Chancellors, Provosts, university administrators and researcher-scientists for informal discussions that lead to the identification of pressing issues, understanding of different perspectives, and the creation of plans of action to enhance research productivity within our institutions. This year's focus is on the challenges regional Universities face in the effort to sustain and enhance their research missions. The 2010 Merrill retreat provided an opportune time to consider leadership strategies for best supporting our public universities in difficult times.

Our 2010 retreat featured a trifecta of top university leadership. Our keynote speaker for the event, Dr. James Moeser, first presented at the Retreat in 1997, as one of the inaugural event's invited speakers. In this year's presentation he summarized ten general principles he has drawn from his years as chancellor, particularly from his eight years at UNC. His presentation was followed by Harvey Perlman, Chancellor of the University of Nebraska-Lincoln, also a previous participant in a Merrill Research Retreat (2004). Chancellor Perlman spoke about the current challenges to leadership of public universities. The anchor spot in the 3-way line-up, in her first participation at a Merrill Research Retreat, was Chancellor Bernadette Gray-Little of the University of Kansas, who also served as host of the event. She offered her perspectives on the current climate facing the highest leadership

levels of public universities, and she then guided the participant group in a discussion of the issues raised in the talks. Collectively, the three papers allow readers to consider the overlaps and shared perspectives among the three leaders of public universities.

Benefactors Virginia and Fred Merrill make possible this series of retreats: *The Research Mission of Public Universities*. On behalf of the many participants over more than a decade, I express deep gratitude to the Merrills for their enlightened support. On behalf of the Merrill Advanced Studies Center, I extend my appreciation for the contribution of effort and time of the participants and in particular to the authors of this collection of papers who found time in their busy schedules for the preparation of the materials that follow.

Twenty-three senior administrators and faculty from four institutions in

Kansas, Missouri, and Nebraska attended the 2010 retreat. Though not all discussants' remarks are individually documented, their participation was an essential ingredient in the general discussions that ensued and the preparation of the final papers. The list of all conference attendees is at the end of the publication.

The inaugural event in this series of conferences, in 1997, focused on pressures that hinder the research mission of higher education. In 1998, we turned our attention to competing for new resources and to ways to enhance individual and collective productivity. In 1999, we examined in more depth cross-university alliances. The focus of the 2000 retreat was on making research a part of the public agenda and championing the cause of research as a valuable state resource. In 2001, the topic was evaluating research productivity, with a focus on the very important National Research Council (NRC) study from 1995. In the wake of 9/11, the topic for 2002 was "Science at a Time of National Emergency"; participants discussed scientists coming to the aid of the country, such as in joint research on preventing and mitigating bioterrorism, while also recognizing the difficulties our universities face because of increased security measures. In 2003 we focused on graduate education and two keynote speakers addressed key issues about retention of students in the doctoral track, efficiency in time to

degree, and making the rules of the game transparent. In 2004 we looked at the leadership challenge of a comprehensive public university to accommodate the fluid nature of scientific initiatives to the world of long-term planning for the teaching and service missions of the universities. In 2005 we discussed the interface of science and public policy with an eye toward how to move forward in a way that honors both public trust and scientific integrity. Our retreat in 2006 considered the privatization of public universities and the corresponding shift in research funding and infrastructure. The 2007 retreat focused on the changing climate of research funding, the development of University research resources, and how to calibrate those resources with likely sources of funding, while the 2008 retreat dealt with the many benefits and specific issues of international research collaboration. The 2009 retreat highlighted regional research collaborations, with discussion of the many advantages and concerns associated with regional alliances.

Once again, the texts of this year's Merrill white paper reveal various perspectives on only one of the many complex issues faced by research administrators and scientists every day. It is with pleasure that I encourage you to read the papers from the 2010 Merrill policy retreat on *Sustaining and Enhancing the Research Mission of Public Universities*.

Executive summary

The Task for Leadership: Sustaining Research Excellence in Uncertain Times

James Moeser, Chancellor Emeritus, University of North Carolina at Chapel Hill

- Lower the walls of the silos to facilitate inter-disciplinary work. Create inter- and multi-disciplinary research clusters to address large problems.
- The greater the attempt, the greater the reward, and the greater risk for failure. Fear of failure often leads to the greatest failure of leadership – the failure to act.
- In developing institutional strategic objectives, one must always begin with an honest institutional assessment. I strongly believe in setting high goals, but those goals need to be grounded in reality.
- Facilities matter. We are, indeed, in an arms race. Good research facilities are a magnet for faculty and graduate students.
- Faculty have to be recruited in clusters in order to create major new initiatives, in addition to traditional departmental replacement hires. This requires an over-all architecture for strategic investment.
- Strong support from the state for research can leverage stronger federal and private support. We must never apologize for research, but rather celebrate it and find ways to connect it to people's lives.
- Public support for faculty compensation is vital. Faculty compensation is the most critical area of national competition. Everything hangs on the quality of the faculty.
- To be successful in big science, institutions need to think strategically, placing bets by allocating resources where there may be a big return. The major responsibility of top leadership is to set a vision and to be the cheer-leader-in-chief in articulating that vision to the university's many constituencies.
- A culture of entrepreneurship is a critical value. Success in economic development and job creation is the best argument for continued support for research. Avoid the traps. Don't overplay this hand. This must not be the only metric of success. The funding stream from licensing is not the goal.
- A great research university must maintain a balance, an equilibrium, between those areas that garner major external funding, and those that never will. It is a primary responsibility of top leadership to maintain areas of strength in key areas of the arts, humanities, and social sciences. *This takes vision and courage.*

Lingchi and the Modern Research University

Harvey Perlman, Chancellor, University of Nebraska-Lincoln

- Public universities are among the many public services feeling budget restraints in an era where there is little taste for raising taxes. At the University of Nebraska-Lincoln during the period when I've been Chancellor, we have been asked to address seven different budget reductions.
- Going forward, we can continue to do what we do with less resources—that is become more efficient, or we can find additional sources of revenue—that is become more entrepreneurial. Either approach presents risks to the core values of higher education, but failing to do either may present even greater risks.
- Beyond intensifying our efforts in recruitment, both within and outside Nebraska, we see some additional sources of enrollment growth, such as on-line education and a greater percentage of paying foreign students. Could we structure a curriculum and a financial aid system that would allow us to charge higher tuition for a more intense experience?
- There is no question that the costs associated with different disciplines is differentiated. There remains, however, a traditional theme of trying to facilitate student choice at the undergraduate level by removing financial considerations. It seems likely that differentiated tuition will be part of the landscape of higher education as we go forward.
- The university's role in the research enterprise seems to me to be evolving into bearing the most significant and uncertain risks associated with innovation. All of the resource pressures facing public universities continue to erode our ability to bear these risks. To sustain our research enterprise we increasingly seek partnerships with private sector companies whose tendencies are to push us further toward the applied end of the research spectrum.
- I remain confident that research universities will continue to adapt and evolve as external resource constraints require. I remain optimistic that deep in the American psyche there is an understanding of the importance of the research university to the country's survival.

Response

Bernadette Gray-Little, Chancellor, University of Kansas

- National public research universities are asked to generate and spin off research, train the workforce, drive the economy, enhance quality of life, and keep this country competitive in the world. That's a tall order, especially during a time when we're facing new challenges.
- Some of our challenges are financial. At KU we have had two big cuts over the last two years that totaled more than \$40 million when the mandates are factored in. This situation is faced by research universities around the nation. In many instances their financial situations are more dire than ours.

- Both of our speakers' comments point to the need to focus, to carve out areas of excellence, and to be hard-nosed in setting a course and staying on it. At the same time, there is a need to think big and be expansive, but to not try and do too many things at once.
- That forces difficult decisions, especially when it comes to allocation of resources such as money and time. That will require us to expect more of our incoming students, but also more of ourselves as recruiters, teachers and mentors. It will also require us to take a hard look at everything, from advising to our general education requirements.
- We also must address the challenge of graduate education, particularly how we provide funding to our doctoral students that allows them to succeed in the many roles we ask them to take on. And we must increase our scholarly output, but not just in research areas that are grant-based. The full spectrum of scholarly and creative activities must be promoted.
- Before we can even move forward on increasing our output, we have to do a better job of measuring it. Current measures like grant awards or papers don't give a complete picture. And without a complete picture, we can't identify the departments that need to improve their performance, or identify those units that are doing a good job and can serve as models.
- And as we deal with these challenges, we are at the same time seeking to convince parents, students, legislators, business leaders, alumni, donors and others of the importance of public research universities to the future of the nation and the prosperity of our states. I think both Dr. Moeser and Dr. Perlman would agree that it is a surprisingly difficult task.

Building Synergies

Jeffrey Vitter, Provost and Executive Vice Chancellor, University of Kansas

- The foundation for much of our current economy is basic fundamental research performed many years earlier by our universities, without immediate payoff. The prosperity of our grandchildren and great grandchildren will depend upon the seeds of innovation that we lay today — in our universities.
- Solutions to the grand challenges we face in society — energy, health, sustainability, and human relations — will require deep expertise from multiple disciplines. 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.**
- 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.

- It is important to embrace a dual philosophy of excellence — excellence in cross-disciplinary collaborations as well as in core disciplines. We should not limit creativity to traditionally valued forms of research. Instead, let us find creative ways to unleash faculty and student creativity to discover amazing new forms of knowledge and wisdom.
- Another fundamental responsibility that universities have is 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 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.
- Synergy truly plays a fundamental role in research scholarship in a number of ways and at a variety of levels. 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.

Lemons to lemonade: Finding new opportunities in a challenging time

April C. Mason, Provost, Kansas State University

- As Provost and Senior Vice President, I have identified a number of strategies to increase research and development expenditures that I share with this group. These strategies will not surprise any in this room; however I do want to highlight the University’s unique opportunity with each strategy and describe how I feel these strategies are helpful to all public research institutions.
- Diversify funding sources: The public research university must have a deep, diverse portfolio of funding sources. Federal grants have traditionally been the key to funding research on our campuses. However, finding other funding sources is also essential. State contracts, block grant competitions, foundations, and industry grants and contracts must be added to funding portfolios. The successful university is the one that diversifies and stays current on funding criteria.
- Collaborate: Technology has assisted greatly in making distance collaboration easier. Funded projects of the future will be collaborations, multi-disciplinary efforts, multi-institutional projects with no room for silos. This type of work is not without difficulties for our faculty. University officials should be responsive to the organizational needs of

large multi-institutional research proposals, as the complications these types of projects bring is high.

- Build on strengths: The universities represented at the Merrill conference are similar in many ways, but have individual strengths and expertise. Today is the time to capitalize on those unique strengths. At K-State we have been able to build on the strengths of our veterinary medical research. The investments made in an already recognized strong area are strategic and heighten the status of that area.
- Grow where planted: There are unique opportunities each university can enjoy solely as a result of where it is physically located or where we have historically invested. K-State enjoys a number of strengths that arise from both place and historical investment. K-State has built on the areas of wheat and beef production to become national and international leaders. These two areas of agriculture are essential to the economy of the state. Partnerships with the industry, industry organizations, state agriculture and local producers are key to a sustainable crop and animal production system.
- Be opportunistic: K-State invested strategically in the Biosecurity Research Center, Pat Roberts Hall, with its high level animal and plant disease research facilities. This facility was expensive to build and is expensive to maintain. It has, however, been central to the competition for the NBAF facility and the attraction of many new investments in the Manhattan area. The focus of research on infectious diseases continues to grow.
- Hire well: The hiring of new faculty to become the university of tomorrow is more and more critical. The faculty we recruit today will need to be competitive in the ever changing research arena. They will need to stay relevant in the classroom as well as in the laboratory, studio or library. We as administrators invest time, energy and resources in each new hire. We want to invest well for the future. As resources allow us to hire, we need to build on strengths and form synergies for success. After the hire we need to mentor for the continued success of each and every faculty member.
- Today's environment is one of competition for limited resources, declining state and federal funding and escalating infrastructure needs. We will need to work together to share strategies and opportunities to control our own future in this changing world. The truly great resource we all have are people who are passionate about their work and the discovery of new knowledge in an educational setting. With that resource we are well prepared for any uncertain future.

Integration of Infrastructure and Process for Enhancement of the Research Mission of the University of Missouri

James English, Professor, University of Missouri

- University research communities are highly diverse both in areas of scholarship and approaches to investigation. The University of Missouri community is typical of this complexity and includes more than 1,900 faculty and instructors associated with 286 degree programs.

- The basis for success of the university's research mission is effective integration of institutional resources (including physical and human) and support processes. At the University of Missouri these support resources are provided at multiple administrative levels, including the department, college, and the Office of Research at the campus level.
- Support for faculty research can be informal through peer mentoring or formal through a variety of administrative mechanisms that provide equipment, technical expertise, funding opportunities and administrative assistance. Examples of formal support include funding opportunities provided through the Research Council, and equipment and technical expertise provided by the Research Cores and Centers within the Office of Research.
- There is a need to constantly assess the quality of resources directed to support the research mission and any needs for enhancement. An example of this is the annual evaluation by the University of Missouri's Office of Research of its Master Plant for Research and Technology Development.

Building Infrastructure to Enhance Integration of Research and Education

Beth Montelone, Associate Dean of the College of Arts and Crafts, Kansas State University

- One way to sustain and enhance the research mission of a public university is to link it to other components of the overall mission of that institution. If research and scholarly activity can be coupled to the instructional or land grant aspects of the institution, it helps to illustrate the value of research to all components of the overall mission.
- A perusal of grant solicitations reveals some words and phrases currently in vogue that suggest the directions in which funding agencies think that the research enterprise should be heading. Among these are: Collaboration, Innovation, Integration, Interdisciplinary/multi-disciplinary, and Assessment/evaluation.
- The barriers to collaborative and interdisciplinary research within K-State include its traditionally decentralized culture, which vests extensive power in departments, as well as regulations of the Kansas Board of Regents regarding student enrollment minima for graduate programs.
- Nonetheless, progress has been made in recent years at K-State toward the national trends promoting collaboration and interdisciplinary work. These include an internally funded research support program as well as other programmatic efforts to link isolated education and outreach efforts and provide central resources to facilitate linking research and education.
- The K-State Targeted Excellence (TE) program solicited proposals during five evaluation cycles from 2003-04 through 2007-08. This program was funded from tuition monies and managed jointly by the K-State Provost's Office and Vice President for Research Office. It was intended to "enhance those programs (primarily inter-disciplinary) with the most promise of elevating the university's stature."

- A total of 29 distinct projects were funded over the lifetime of the program; some represented relatively small investments to initiate projects (ca. \$100,000), while others were large collaborative awards of \$2M over multiple years.
- Some of the projects established using TE funding have subsequently been developed into major extramurally funded projects. Many of these are interdisciplinary in nature. Other projects focused on promoting collaboration among faculty members and across units at K-State, while some collaborative initiatives have emphasized linkages outside the university.
- Under a shared vision of broadening participation in STEM disciplines and integrating research and education, we proposed developing an institutional infrastructure to increase the synergy among existing programs, support assessment efforts that identify practices best suited to the economic and social climate within which K-State operates, broaden STEM faculty involvement in collaborative activity and innovative programming, and guide programmatic/policy decisions at departmental, college, and university-wide levels.

The Institute of Advancing Medical Innovation (IAMI): Stepping into the future of academic research and entrepreneurship

G. Sitta Sittampalam, Professor of Pharmacology, Toxicology, and Therapeutics; Deputy Director, IAMI, University of Kansas Medical Center

Scott Weir, Professor of Pharmacology, Toxicology, and Therapeutics; Director, IAMI, University of Kansas Medical Center

Michael Hughes, Project Director, IAMI, University of Kansas Medical Center

- Academic research in science and technology has been one of the main drivers in economic development, prosperity and dramatic improvement in public health in the developed countries. The Institute for Advancing Medical Innovations (IAMI) currently in place at the University of Kansas (KU) is a bold step to promote translational research in Kansas and the Kansas City region. We anticipate that this effort in partnership with the Kauffman Foundation, Kansas Biosciences Authority (KBA) and regional animal and bioscience industry will promote entrepreneurship and economic development.
- IAMI supports Proof-of-Concept (POC) projects in drug discovery and delivery along with innovative approaches to drug-device development that can lead to commercialization through start up companies based on research funded at KU. Partnerships will be encouraged with national and international universities, companies and philanthropic organizations to deliver life-saving products to patients. Revenues from these activities will be used to fund translational research at KU and the Kansas City region. As part of this effort, IAMI will provide training and mentoring for faculty and students on entrepreneurship, business development, intellectual property management and venture funding in collaboration with the KU Business School and the University of Kansas Center for Technology Commercialization (KUCTC).
- Many discoveries may have benefits for patients and the public and require rigorous research development activities before commercialization. In the past, this aspect of

translational research was generally not funded by federal agencies or philanthropic research organizations, but carried out by multinational corporations and biotechnology companies based on academic publications. Projects at this stage are too early for venture capital investment and too advanced for basic research funding. IAMI targets the translational research activities with specific milestone-based funding and project management support from industry experienced project managers and adjunct faculty.

- Academic research supported by federal agencies have narrowly focused on basic and applied science and technology that results in publications and serves the educational missions of our universities. However, there is very little funding or infrastructure that supports translational research and promotes entrepreneurship, commercialization and job creation. Traditionally, the discoveries from academia have been exploited by multinational corporations and biotech industries concentrated in a small number of regional centers. More and more, local and state governments are recognizing job creation potential and its impact on economic development in their backyard - IAMI is an example of this desire to exploit academic innovations.
- IAMI is an innovative idea to support faculty entrepreneurs and local and regional economy by leveraging industrial expertise to commercialize discoveries at KU. By encouraging partnerships between researchers at both campuses and providing project management expertise, process re-engineering and training, we are fostering a culture of collaboration and innovation. An ultimate challenge in creating such models in the academic environment is its sustainability over the long term and its impact on the local and national economies.

Positioning the University in the World of Higher Education Research

Brian Foster, Provost, University of Missouri

- MU began a process to identify the competitive assets that could be the foundation for long-term initiatives to position the university for increased impact. A task force was formed by the provost to frame the process, identify potential strategic advantages, and to seed a broader discussion with faculty, deans, alumni, students, staff, and others.
- There was broad agreement that we would not create new “silos”, but rather each initiative would be associated with a network of MU faculty, centers, departments, staff, core facilities, and external collaborators. The networks would be guided by a facilitator whose charge is to bring people and organizations together in productive collaborations.
- There was also broad agreement that the network for each initiative would be very inclusive: the initiatives were framed specifically to allow this breadth of participation. Each of the five initiatives can readily include participants in humanities, physical sciences, engineering, biological sciences, professions (medicine, veterinary medicine, law), business, education, journalism, social sciences, agricultural disciplines, and others.
- The five initiatives are: One Health, One Medicine, Food for the Future, Media of the Future, Sustainable Energy, and Understanding and Managing Disruptive and Transformational Technologies. MU already has considerable strength in these five areas.

Our goal is to strengthen these broad areas in ways that enhance MU's impact and stature.

- Targeted conferences, workshops, symposia, and other events bring potential partners together for relevant interaction. The relationships formed at the events themselves support the research networks and greatly enhance the vitality of campus intellectual life. A diverse set of people at MU are using state-of-the-art network analysis techniques to model our collaborative networks and the potential relationships that could be brought into the networks.
- A key objective of the implementation for the five initiatives is to make the walls of existing silos very penetrable. The goal is NOT to eliminate or compromise the disciplines, but to bring them together in productive, synergistic ways.
- The facilitators for the Mizzou Advantage are focused not just on making relations among collaborators, but also on constructing robust network structures that are not vulnerable to loss of a single key individual or two. Critical support comes in important functional areas: support for event coordination, professional support for writing grant proposals, and additionally, the five initiative areas are such that they may provide opportunities for major gifts from donors who want to "change the world" in an area for which they have a strong passion.

The Quest for NCI Designation and the Power of Vision and Focus

Barbara Atkinson, Executive Vice Chancellor, University of Kansas Medical Center

- The University of Kansas Medical Center has been building a National Cancer Institute (NCI)-designated Cancer Center. We had already begun this effort when, in September 2005, then-University of Kansas Chancellor Robert Hemenway announced that attaining NCI designation for our cancer center was the University's number-one priority.
- The University of Kansas Medical Center had been working on cancer since 1969. During the early 1970s, the NCI awarded us funding to investigate the feasibility of establishing a clinical cancer research center in Kansas. By the 1990s, the University of Kansas Cancer Center (KUCC) was experiencing steady growth in terms of funding and pioneering research. Such growth warranted formalizing the KUCC's research arm as the Kansas Cancer Institute.
- Three things would make The University of Kansas Cancer Center unique: 1) our expertise in drug discovery, development and delivery; 2) our strong research in cancer prevention and control; and 3) the development of a community-based approach to cancer research through the creation of the Midwest Cancer Alliance.
- In 2004, we recruited our Center's first full-time director, Roy A. Jensen, MD, a nationally recognized breast cancer researcher and pathologist from the NCI-designated Vanderbilt-Ingram Cancer Center. In early 2006, Dr. Scott Weir joined The University of Kansas Cancer Center. With \$8.1 million from the Kauffman Foundation and a challenge match of

\$8 million from KU Endowment, we were able to create the Institute for Advancing Medical Innovation, which Dr. Weir now leads.

- In 2007, we formed The Midwest Cancer Alliance to bring cutting-edge clinical trials, the latest prevention and screening tools and continuing education opportunities to a region-wide network of hospitals and health care organizations. We wanted to advance the quality and reach of cancer prevention, early detection, treatment and survivorship methods.
- Leading this effort is Gary Doolittle, MD, another native Kansan with deep connections to the rural parts of our state. People throughout the state have great affection for Dr. Doolittle, who brings health care to remote places in Kansas via telemedicine, twice-a-month trips to conduct an oncology outreach clinic at Hays Medical Center in western Kansas and monthly visits to the Horton oncology outreach clinic in the Northeast corner of the state.
- Strong in the knowledge that our Cancer Center is distinguished by these three unique and valuable elements, we proceeded to tell our story over and over again as we set about finding the resources necessary for NCI designation. The NCI has invited us to apply as early as September 2011.
- Achieving NCI designation could create to 9,400 new jobs for the state, pump \$1.3 million dollars into our state's economy and almost double the amount of grant dollars for KU Cancer Center researchers. It would certainly bring a great deal of prestige to the University of Kansas. But most importantly, it would mean our families, friends and residents could stay in Kansas to get the highest quality cancer care in the country.

Focus on the Enterprising Researcher to Sustain Research Universities

Kimberly Espy, Associate Vice Chancellor for Research, University of Nebraska-Lincoln

- From the perspective of the individual researcher, sustaining research universities is fundamentally about actions that initiate, enable, and enhance the research enterprise, coupled with those that reduce barriers that get in the way.
- Enabling researchers to be able to chase down a "hare-brained" idea, to debunk conventional thinking, to develop the alternative method or approach, which impacts national needs and transforms the field is the key feature of a vibrant, sustainable research university.
- Current practices for hiring faculty have not changed substantially in decades, and yet the availability of well researched, valid information on how to effectively recruit, select, and hire has burgeoned. In order to sustain the enterprise, updated hiring methods to directly assess the enterprising qualities of candidates, and more systematically consider these characteristics in selection, would benefit institutions broadly.

- In the last decades, the increased demands placed on faculty are not uniformly distributed. The expectations for service and teaching for faculty who are more focused on research largely has not changed. Apportioning faculty responsibilities to best fit skills and interests in a dynamic, flexible manner undergirds an enterprising, sustainable institution.
- Institutions can do a lot to minimize burden – by retaining adequate funds and providing staff for budget and proposal assistance. Providing full service help supports faculty, who are then less fettered by such concerns and have more time and energy to devote to doing research.
- Sustaining the research enterprise fosters interactions and collaborations among researchers from various disciplines, who have different perspectives, training and methods, but share a common commitment to the problem or question at hand.
- Graduate study is under subtle attack. Declining budgets result in reduced graduate assistantships, and inequities in the funding model make it more cost effective to hire a technician or post-doctoral fellow than train a graduate student. The system of graduate student support needs rethinking, with a greater partnership by the federal government. Sustainable models for graduate study is a key element of the research enterprise and strengthening researcher universities.
- The research university is a direct reflection of its enterprising faculty scholars. Working from the microcosm of the researcher is an important perspective to remember in considering efforts to sustain research universities.

Research and Imagination in the Twenty-First Century: Liberal Arts and Sciences

Danny Anderson, Dean, College of Liberal Arts and Science, University of Kansas

- Within the context of an international public research university like the University of Kansas, I see the work of the liberal arts and sciences as drivers of the imagination within our research mission. The liberal arts and sciences are foundational for sustaining and enhancing the research mission of public universities in the twenty-first century. And it is the imagination fostered by a liberal arts and sciences education that lays this foundation.
- The twenty-first century has begun with a conversation about higher education, mainly focusing on challenges and obstacles. In his inaugural address, President Barack Obama voiced the commitment to “transform our schools and colleges and universities to meet the demands of a new age.” Both the American Association of Universities (AAU) and the Association of Public and Land-Grant Universities (APLU) have weighed in on this conversation as it has related to research universities.
- While this conversation is robust, one topic is missing: the role of liberal arts and sciences within public research universities. The *Chronicle of Higher Education* in a special group of articles (5 March 2010) discussed “the new liberal arts” in private liberal arts college, regional state universities, online/for-profit institutions, and honors programs in large

state universities. In each of these cases, workforce development and rising enrollment in professional programs are the drivers behind the new liberal arts.

- In a large public research university, the college of liberal arts and sciences is usually the administrative cornerstone for the institution. It serves as a home for many of the general education goals. With the foundational importance that the liberal arts and sciences play in this role, it is crucial to understand how they foster the imagination needed to ensure prosperity in the future.
- Within a public research university, the liberal arts and sciences are the intellectual home for students who seek an education on how to think like researchers, how to test ideas - an education that pushes them to develop original solutions to complex problems, and that propels them to rely upon their imagination when visioning the world of the future.
- The role of the imagination—fostered through the liberal arts and sciences—is foundational for the goals of professional education. The global challenges in cross-cultural relations and understanding, demographic flows, security, energy, environment, communications, trade, and economic interconnections must be addressed by the imagination on the way to creating new realities.
- It is the goal of the liberal arts and sciences to propel and energize the imagination, to remove the limits to the content we can dream of creating. These dreams are crucial for our globe, but they are also crucial for our homes, for the quality of our everyday lives. The liberal arts and sciences are an intellectual home for the imagination, and through the imaginative acts we encourage, we bring our research home to improve our lives.

Reconsidering the Architecture of Research in the Public University

Jack C. Schultz, Director, Bond Life Sciences Center, University of Missouri

- The National Academies' report "Rising Above the Gathering Storm", issued in 2007, emphasized the need not only for preserving, but revitalizing the nation's investment in science and math education as well as in basic research. That need was reinforced in the University Leadership Council's National Best Practice report, "Competing in the Era of Big Bets" (Education Advisory Board, Washington, DC) which emphasized the importance of multidisciplinary research, especially during perilous economic times.
- The focus of the ULC's report, *Achieving scale in multidisciplinary research*, points to an important role for collaborative, interdisciplinary approaches to science in weathering economic storms. Solving most modern problems requires more kinds of expertise than single investigators can provide. The rules and laws governing networks, most of which apply to any kind of network, are also at work in forming and maintaining research teams. Multi-investigator research collaborations are social networks.
- Training has not kept pace with changes in modern life sciences research - the culture of research training continues to emphasize individual, independent work. The life sciences have always employed statistical and modeling approaches, yet today use of bioinformatics has become *de rigueur* in many areas of biology. Another skill set that is

almost never addressed in training researchers is the ability to communicate with diverse audiences, including the public. Failure to do this well has contributed to a growing public view that science and research comprise no more than another special interest group.

- How can we change a culture of independence to one that recognizes the value of cooperation and information exchange? A cultural shift like this requires the spread of new attitudes about how we work and what is useful. Identifying individuals with the attitude and resources that facilitate becoming a hub and placing them into a multidisciplinary environment can create a topology that facilitates collaboration. This is, of course, an aspect of what is commonly called mentoring.
- Physical proximity combined with attention to individual attitudes about collaboration, the composition of expertise and interests, and a mix of more- and less-experienced investigators is likely to maximize emergent, novel research outcomes. Willingness and ability to collaborate or at least work across disciplinary boundaries can be evaluated in new hires. Faculty and institutional promotion and tenure committees need to support collaborative research consistently.
- Locating researchers on the basis of problems to be solved or other common interests is a promising new idea on university campuses that could become a trend. Lunch areas or even cafes near research areas keep researchers nearby and encourage conversation. Designing meeting spaces of varying sizes into research facilities promotes both scheduled and opportunistic meetings. Developing a database that allows investigators to find each other, or organizers to assemble teams is vital. These need to be kept up to date and edited for consistency.
- Institutions must establish policies with respect to how coauthored products are evaluated, and see to it that these are enforced from department to campus-level committees. They must foster credit- and resource-sharing among academic units so that a win for one is a win for both. Institutions need to allow shared credit and double-counting on grants, and make sure that all units sharing in a success are acknowledged.

The University of Kansas Research Engagement Initiative

Steve Warren, Vice Chancellor for Research and Graduate Studies, University of Kansas

- Given their complexity and cost, the scholarship and creative activities conducted at research universities must over time be able to demonstrate a substantial impact on society to justify that their cost and “specialness” is worthy of meaningful levels of tangible support.
- In the fall of 2008, I led an effort at KU to determine the extent of research engagement by university faculty over the previous ten years. The analysis was limited to our history of obtaining external research funding during the previous decade (1998-2008). Our analysis revealed that during the previous decade, participation by faculty in grant supported research remained remarkably flat at approximately 50% of faculty. Our analyses also

indicated that participation by faculty in externally funded research was remarkably uneven within many departments, and for some departments overall external funding was lower than might be expected given the availability of federal programs to support research in their given disciplines.

- A natural implication of this data was that we could potentially achieve higher levels of research engagement on the Lawrence campus. Shortly thereafter Chancellor Gray-Little appointed 19 faculty members to serve on a Research Engagement Task Force. Our charge was straightforward: To identify appropriate measures of research engagement, and to suggest specific approaches to promote, increase, sustain, and recognize all types of research engagement by faculty.
- The final report of the task force was submitted to the Chancellor on March 24th, 2010. Consequently, KU has begun the process of creating a “comprehensive system for measuring research engagement” and all Deans on the Lawrence campus, and all Chairs at KUMC have been asked to submit their initial plan for sustaining and enhancing research engagement in their respective faculties.
- The overall goal of the research engagement initiative is to sustain highly-engaged departments and programs while substantially increasing the number of departments engaged at this level across the university. A sustained effort over many years will be required before the extent of our efforts to do this can be reasonably determined.

The Water for Food Institute at the University of Nebraska: Growing More Food with Less Water – an Opportunity for Collaboration

Prem S. Paul, Vice Chancellor for Research and Economic Development, University of Nebraska-Lincoln

Monica Norby, Assistant Vice Chancellor for Research, University of Nebraska-Lincoln

- By 2050, the world population is expected to increase 40 percent, and the demand for food will double. This escalating demand on agriculture to produce food, feed, fiber, and fuel will exert intense pressures on the quantity and quality of our water resources.
- The University of Nebraska recognized that there is a critical need for a focused global effort to bring together expertise from many disciplines, including basic and applied water and agricultural sciences and economic and behavioral sciences, to conduct research focused on producing more food per unit of water. To meet that need, the University is establishing the Water for Food Institute, a global research, education, and policy analysis institute committed to helping the world efficiently use its limited fresh water resources to ensure the food supply for current and future generations.
- Currently, more than 160 faculty at the University of Nebraska have expertise related to water and food. A faculty taskforce was formed to discuss issues related to water, map institutional expertise in those areas, and develop a vision for moving forward. As a first step, they recommended we hold an international conference to better learn about the challenges and to gather input from diverse experts in food and water on the need for

such an institute and the ways to organize it. The Future of Water for Food Conference was held in May, 2009.

- A main goal of the conference was to explore how a global institute addressing water and food security established at the University of Nebraska could develop the programs and partnerships to effectively address these issues. Additional information can be found in the *Proceedings of the Future of Water for Food Conference*, available at: <http://waterforfood.nebraska.edu>.
- On April 20, 2010, the University of Nebraska was fortunate to receive a \$50 million founding gift commitment from the Robert B. Daugherty Charitable Foundation to support the global Water for Food Institute. The Water for Food Institute will be a “distributed” institute, with a core group in Lincoln and partners throughout the region and the world. These partners may be from other universities, the public sector (foundations, government agencies, NGOs), and the private sector. The Water for Food Institute will be formally established by the University of Nebraska Board of Regents in October, 2010, and the search for an executive director is underway.
- The course the University of Nebraska pursued in developing and establishing the Water for Food Institute can serve as a potential model for thinking about and doing big things. To sustain and enhance our research mission in these challenging economic times, we cannot afford to narrow our thinking. A big idea like the Water for Food Institute offers a great opportunity for our neighboring universities, who also offer substantial expertise in the use of water for agriculture and a deep understanding of its importance, to partner with us in making a difference on this global issue.

Toward Opportunities for Regional Collaborations in Drug Discovery in the Midwest

Robert V. Duncan, Vice Chancellor for Research, University of Missouri

- We at MU propose a new regional collaboration in cloud bio-computing, shared core facility support, transgenic animal model development, and clinical trials that will compete successfully with other drug discovery activities elsewhere in the United States, and throughout the world.
- The region’s outstanding capabilities, coupled with the emergence of a new emphasis on regionalism, promise to create the environment necessary for this region to emerge as the point of choice for drug and human health care development world-wide within the next five years.
- Regional efforts will succeed over the competition if the complementary strengths across the Midwest Region are effectively brought together in a single, external marketing operation. Nothing will prevent each institution’s efforts to solicit other business alone simultaneously, but all institutions will need to agree not to interfere or compete with a particular deal that is being negotiated by the non-profit on behalf of all institutions.
- The development of high-end computing for computational drug discovery, interface data acquisition, management, for bioinformatics of massive amounts of genetic and proteomic

data, and applications individually to the advent of personalized medicine, are a current critical missing component of our efforts to develop a Midwest engine in drug discovery.

- Once a substantial capability in both bioscience cloud computing and in shared core laboratory facilities are established within the Midwest Region, the next step will be to get the leading investigators who are active in drug discovery at our various institutions and at KCALSI to meet at each other's locations with a very concentrated focus on how we can specifically build on each institution's strengths to make the Midwest Region more competitive than other locations across the United States for all aspects of drug discovery.
- The next step will be to take a comprehensive approach to define the Midwest Region as the optimal location for major drug discovery. The close collaborations that emerge from this effort will likely lead to new regional opportunities for additional work beyond drug discovery.

The Big Five at the University of Kansas Medical Center : Remaining Competitive in Today's Research Environment

Paul Terranova, Vice Chancellor for Research, University of Kansas Medical Center

- The term 'Big 5' was established as the five established research areas at the University of Kansas Medical Center and includes Cancer, Reproductive Sciences, Neurosciences, Kidney and Liver. Each of these areas is an established disease or organ-based Center or an Institute at the Medical Center.
- Each of the Big 5 has a founder and/or a director with significant accomplishments nationally and internationally and a desire to conceive and build new programs and grow existing programs.
- Each of the Big 5 has shared resources that support research programs within each Center/Institute as well as non-center/institute members throughout the university. Each of the Big 5 has program grants, including collaborative research projects such as U54, P01 and P50 and core based grants (P30). The collaborative research projects usually include the majority of project leaders from within the university but subcontracts are also signed with other collaborative universities.
- Each of the Big 5 is continually recruiting students through networking and advertisements at national and international meetings. Each of the Big 5 have consolidated space including laboratories, shared resources, offices and administrative area. Consolidated space promotes scientific interactions and the resulting collaborations can be significant in the form of joint grants and publications and sharing resources. Consolidated research and administration also increases the visibility of the center/institute within the university and for invited guests, e.g., seminar speakers, external advisors and review teams.
- Each of the Big 5 have nationally prominent scientists acting as External Advisory Board members. External advisory board members very helpful in reviewing program grants

prior to submission to the NIH or other granting agency. Each of the Big 5 has well-established collaborations within the center/institute and university as well as with other universities. Collaborations may be local, national, and international and involve students and faculty that have joint publications and grants and share technologies.

- Each of the Big 5 has a seminar program and an annual symposium/workshop. The seminar program and annual symposium increases the visibility of the center/institute, an invaluable component. Each of the Big 5 is involved in outreach that includes other centers/institutes and departments within the university, and the local, national, and international communities. Outreach has an educational component that provides information about the activities of the center/institute as well as a fund raising component to support specific initiatives.

Growing Sage

Susan Kemper, Roy A. Roberts Distinguished Professor of Psychology, University of Kansas

- Most discussions of research productivity and senior faculty start and end with a consideration of the implications of the elimination of mandatory retirement policies in 1994. Aging faculty are assumed to be nonproductive at best. To use an agrarian metaphor: to ensure a good crop, the assumption seems to be that we must plow under the sage to make room for the oats. I want to challenge this assumption.
- The “aging” of the professorate is not a result of faculty members ‘postponing’ retirement, but reflects ‘scarcity’ of young faculty members. Holden and Hansen (2000) as well as other surveys (Bland & Bergquist, 1997) have identified a number of demographic changes that affect the age distribution of faculty: our “young” faculty are 10 or more years older on average than those hired in the 1970s and 1980s.
- I would take issue with the assumption that older faculty members are ‘nonproductive’ and ‘noncreative.’ This view of the relationship between age and achievement is widely held and deeply entrenched, and owes a lot to a series of analyses by Lehman (1953) in the 1950s. His consistent finding was that achievement peaks in the 30s – somewhat earlier in some domains like chess, somewhat later in others like medicine.
- These data, and lots of more recent data both cross-sectional and longitudinal, have been more recently reanalyzed by Simonton (1997). He found that it is ‘career’ age, not chronological age, that determines research and creative productivity. Simonton’s point is that it is that 10 year investment that is critical, not the age at which you launch your career. Simonton has found that productivity peaks at career age of 22, so that if you enter a profession at chronological age of 30, you’ll hit your peak at age 52 and your output won’t zero-out until age 70.
- Gingras et al. (2008) looked longitudinally at the careers of 13,000 professors from Quebec. They show that “active” professors hit a peak rate of productivity in their 40s and sustain their rate of productivity throughout their 50s and 60s. Their impact is somewhat curvilinear, with their ‘best’ works coming both early and late in their careers.

- Shimamura, Berry, Mangels, Rustings, & Jurica (1995) assessed the performance of a panel of University of California, Berkeley faculty, between 30 and 71 years of age, on a battery of tests of memory and cognition. On the tests of learning and retention, they found that the older faculty members did just as well as the younger ones. Indeed, analyses of the relationship between age and job performance across a wide range of domains has found a zero relationship (Charness & Krampe, 2008).
- While we do need to plant and fertilize a crop of young faculty members, we shouldn't just plow under the old. The key to sustaining and enhancing research productivity lies with taking the long-view of research careers as extending well past attaining tenure. The age distribution of our faculties is shifting, in part reflecting global demographics and the 'extension of childhood' and the compression of morbidities as we adjust to the prospect of long lives.

Musings from the Research Infrastructure Task Force at Kansas State University

Chris Sorensen, Cortelyou-Rust Distinguished Professor of Physics, Kansas State University

- On January 19, 2010 President Schulz's formed the Research Infrastructure Task Force (RITF) composed of 14 faculty, administration and staff. He asked me to chair the Task force, and I readily accepted.
- A major, and not at all surprising, finding is: Kansas State University is a student-centered, land-grant university where some fraction of the faculty pursues RSCA to various degrees in their fields of specialty. The public perception of K-State retains the student-centered, land-grant descriptors and includes athletics. RSCA are largely ignored or not understood by the general public.
- The TF found that there has been an attitude that at K-State we do RSCA **too**, not that we do RSCA, and a general malaise exists that RSCA is not as important as undergraduate education and athletics. What to do about this dire situation? Here I propose a number of actions that could help greatly to remedy the situation.
- A **new culture** that advocates, expects and recognizes RSCA must be instilled from the top down, via the central administration, across all disciplines and units. This new culture must extend beyond the campus through the Foundation and the Alumni Association.
- Use our resources. Perhaps the greatest resource of any university is the faculty. The faculty have to be properly supported and used. We must encourage and augment collaboration. We must think and hire with an interdisciplinary, i.e., thematic, perspective. We must beware of territorial deans and department heads. We must build a university without walls!
- The Foundation and the Alumni Association are major resources typically tapped for undergraduate affairs and athletics. It's time to use their great networks and interpersonal abilities to promote the "rest" of the university. Finally, let us not forget the synergy that

exists in the best universities between teaching and the research, scholarship and creative activities enterprise.

- Yes, RSCA creates new knowledge for the good of our society. Yes, a viable RSCA enterprise at a university can give non-classroom experience to the students. In my opinion the greatest synergy comes from the fact that with a viable RSCA enterprise, our students can learn engineering from practicing engineers, poetry from real poets, business from experienced businessmen, and science from research scientists. The insights that these real practitioners have are invaluable and they cannot be found in the textbooks.

The Nebraska Center for Virology: Research, Training, Education, and Outreach

Charles Wood, Director, Nebraska Center for Virology, University of Nebraska-Lincoln

- Established in 2000 as a National Institutes of Health Center of Biomedical Research Excellence, The Nebraska Center for Virology (NCV) won a \$10.6 million, a five-year renewal grant from NIH/National Center for Research Resources in 2005, and was recently approved and funded for another five years of funding to support the infrastructure of the Center. The NCV provides infrastructure support for researchers at the University of Nebraska-Lincoln (UNL), the University of Nebraska Medical Center (UNMC), and Creighton University – Nebraska’s three major biomedical research institutions.
- Research carried out in the center focuses on viral diseases of humans, animals, and plants, which include AIDS, neurodegenerative diseases, and malignancies. The Center has 37 faculty members and is directed by Dr. Charles Wood, a molecular virologist, with co-directors Drs. Howard Gendelman and James Van Etten, and Associate Director Dr. Clinton Jones. A number of new scientists hired in the past seven years have expanded NCV research into the study of human papilloma virus, the Epstein Barr virus and vesicular stomatitis virus, and new arenas of HIV research.
- The NCV is broadening its international work, conducting extensive research programs in Zambia. As a part of this work, the Nebraska team has built a laboratory and clinic at the Teaching Hospital of the University of Zambia and developed close ties with scientists there.
- Training the next generation of virologists, both in the U.S. and abroad, is a critical component of the NCV’s mission and continues to grow. There is an ongoing highly successful program funded by the Fogarty International Program to train Zambian and Chinese researchers on AIDS and associated cancer viruses. The NCV has also established a research training program in comparative viral pathogenesis to recruit and train U.S. graduate students, particularly those from minority and underrepresented groups.
- The NCV’s educational mission extends beyond the scientific community. The Center’s work on HIV evolution is included in a National Science Foundation-funded project called Explore Evolution that includes a permanent exhibit at the Nebraska State Museum, traveling museum exhibits that are touring the U.S., and an outreach program

for 4-H students in five states. Another project, *World of Viruses*, recently funded by the NIH Science Education Partnerships Award program, is a multi-faceted educational outreach program that will feature NCV research in public radio documentaries and in “flexhibits” distributed through public libraries and to 4-H programs in 22 states.

The Task for Leadership: Sustaining Research Excellence in Uncertain Times

James Moeser

Chancellor Emeritus, University of North Carolina at Chapel Hill

I was delighted to receive the invitation to speak at this, the 14th annual research retreat sponsored by the Merrill Center for Advanced Studies at KU. I was privileged to attend and speak to the very first of these retreats in 1997, attending as the relatively new chancellor of the University of Nebraska-Lincoln. At that conference, my task was to be the clean-up hitter, listening to the presentations of faculty from the several institutions, summing up what I heard, and adding my own reflections in a piece I called “The Agenda for Change.”

My task this time as the lead-off hitter is much more daunting, without the benefit of the shared wisdom of those of you in this room to draw on. It is our good fortune that I am followed in the line-up by two great hitters, Harvey Perlman and Bernadette Gray-Little, and I am confident of their ability to knock me in, provided I can get on base.

My charge from Mabel Rice is to articulate *how top leaders can sustain research excellence for a public university in a time of fluctuating and uncertain public and financial support*. She suggested that I might provide a list of the ten most useful things I learned about leading a research university, drawing most heavily from my eight years as chancellor of UNC Chapel Hill. In this paper, I will develop ten general principles, which I hope you will find helpful.

The perspective from the top . . . That reminds me of a story:

A man in a hot-air balloon realized that he was lost. He reduced altitude and spotted a woman below. “Excuse me,” he shouted. “Can you help? I promised a friend I would meet him an hour ago, but I don’t know where I am.”

The woman looked up and replied: “You are in a hot-air balloon hovering approximately 30 feet above the ground. You are between 40 and 41 degrees north latitude and between 59 and 60 degrees west longitude.”

“You must be an engineer,” said the balloonist.

“I am,” replied the woman. “How did you know?”

“Well,” said the balloonist, “everything you told me is technically correct, but I have no idea what to make of your information – and the fact is, I am still lost. Frankly, you’ve not been much help so far.”

"Well," said the woman, "you must be an administrator."

"I am," said the balloonist. "How did you know?"

"Well," said the woman, "you don't know where you are or where you are going. You have risen to where you are due to a large quantity of hot air. You made a promise that you have no idea how to keep. And you expect people beneath you to solve your problems. The fact is that you are in exactly the same place you were before we met – but, now, somehow, it's my fault."

Notwithstanding the cynicism of that little story, I believe that top leadership *can* impact the direction of a university; it *can* help create a climate that supports excellence in research; indeed, it *can* create a culture of excellence in an institution.

A savvy leader, unlike the balloonist, knows where he or she is – not just the geographical coordinates, but more critically, the history and culture of the institution, the state, and the region. Large universities turn like battle ships. Course corrections are possible, but only gradually, by increments.

We must always remember that a research university is a complex organization with a diffuse power structure. Presidents and chancellors lead by persuasion, not by fiat. Indeed, the more successful an institution is in attracting external funding, whether from peer-reviewed grants, foundations, or donors, the more decentralized the institution becomes. A highly successful faculty member can control more resources than many deans or department chairs.

As I began to think about these remarks, it occurred to me that I should review what I said back in 1997. Indeed, the first two principles I will give you this morning come from that earlier paper.

Paul Cheney, a distinguished KU neurophysiologist, made a compelling argument for lowering the walls that divide the many silos inside the academy. He quoted Mark Rogers, then the Vice Chancellor for Health Affairs at Duke, who wrote the following:

*"The institutions that will succeed [in the future] are those that can reorganize themselves to address scientific and educational questions in an interdisciplinary manner. The institutions that will have difficulty are the ones that keep the same rigid structure that prevents pollination among disciplines."*¹

That concept became a mantra for me at Nebraska and later at North Carolina. The more I realized the futility of attempting to dismantle hardened walls, the more I began to use the language of biology to speak of walls that were more like *permeable membranes*.

However one characterizes it, this is an essential culture for a successful research university.

Eli Michaelis, the chair of KU's pharmacology and toxicology department, spoke eloquently about the two factors that drive successful researchers –*uncertainty and urgency*. He also spoke candidly and revealingly about his own fear of failure, observing that the most audacious objectives carried with them the greatest risk of failure. I distilled a principle out of this that I applied to my own objectives for two universities: *The greater the attempt,*

the greater the reward, and also the greater the risk of failure. It is this sobering realization, however, that often leads to the ultimate failure of leadership – the failure to act. Institutions that coast are, by definition, on a down-hill track.

I arrived in Chapel Hill in August of 2000 at a precipitous moment in the history of this, the oldest public university in America. The campus was showing its age. After years of neglect from the state, deferred maintenance was at an alarming stage. Our world-class chemistry department was still teaching and doing research in a 1925 building. The music library, one of the three strongest research collections in America, was housed in a basement of an old Carnegie Library with leaking pipes running overhead. I was replacing a chancellor who had died in office, leaving a substantial structural budgetary deficit. I had to find a provost, a chief financial officer, and a chief research officer.

To counterbalance these problems (which I saw as opportunities) were many positives. First, I discovered an incredibly positive faculty culture. Unlike my experience at three other universities, where the best faculty had opted out of governance, some of UNC's most distinguished faculty were highly active in governance and eager to work with a new chancellor. It was not uncommon for the faculty chair to be a member of one of the national academies. UNC was recognized in the then-just released Lombardi ranking of research universities as one of only four public research universities in the top tier along with Berkeley, Michigan, and UCLA.

I quickly realized that the strategies I had employed at Nebraska, and earlier as provost at South Carolina, with significant reallocation of funds from marginal areas to concentrated and focused areas of excellence, would be inappropriate for a university with very few areas that could be called weak, and many that were excellent and highly regarded. I adopted a strategy that we would have a low tolerance for marginal programs, which meant, with a small number of such programs, we could afford to move resources to shore them up.

(If there is a principle that can be distilled here, I believe it is this:

In developing institutional strategic objectives, one must always begin with an honest institutional assessment. I strongly believe in setting high goals, but those goals need to be grounded in reality).

On the November, 2000 ballot was a \$3.2 Billion higher education construction bond issue, of which \$525 Million was slated to go to Chapel Hill. In my installation address in October, I took a deep breath and pledged to the voters that we would triple that investment in private fund raising if they would approve the bonds. (We were on the cusp of announcing a billion dollar-plus capital campaign, but I had great anxiety about our ability to raise that kind of money. This is an example of my earlier point about the fear of failure.)

Timing is everything – in hand grenades, music, and politics. In November of 2000, the dot-com bust was still over the horizon. People were optimistic. The voters approved the

bond issue with a 75% plurality, passing in all 100 counties. It stands, still to this day, as the largest higher education construction bond ever passed by any state. Fortunately, because of the success of the Carolina First Campaign, which ultimately raised \$2.4 Billion for academic support including 225 endowed chairs, nearly a thousand new scholarships and fellowships, and significant commitments to facilities for research, I was able to relax. At the end of the day, we had increased the state's investment five-fold.

I realized that this was a critical moment in the history of this university. UNC was highly ranked, but also highly vulnerable, due to these obvious deficiencies in the infrastructure and relatively low faculty salaries. Instinctively, I felt that this was the right time for a major investment in big science. We had obvious strengths on which to build, and I knew that it would be a fatal mistake to begin my first big efforts in my own playground of the arts and humanities. I also realized that I needed really a strong internal leadership team to develop a strategy. With my lack of background in science, I needed senior colleagues with strong research credentials. So, I recruited Robert Shelton, the vice president for research of the University of California, a physicist and former department chair at UC-Davis, to be provost. We recruited Tony Waldrop, the vice chancellor for research at Illinois, to take the same position at UNC. (When Shelton left after several years to become president of the University of Arizona, I named Bernadette Gray-Little, the dean of the College and now KU's chancellor, to be

our provost.) I always had a strong colleague in that essential office.

We decided that the capital construction program, which over eight years grew to \$2.2 Billion and more than 6 Million new square feet, would be front-end loaded with research and teaching facilities for the physical sciences, medicine, public health, and pharmacy. We drafted our leading research faculty into planning teams for these new buildings. (The ability to dream and then build new facilities is one of the strongest retention devices I know.) We also used these new facilities, even in the planning stages, as the hooks for recruiting new faculty. Every area of the university was affected by this infusion of support, but none more than the physical science departments of the College – chemistry, physics and astronomy, marine science, biology, and computer science.

Early on, in my very first year, when we were fortunate enough to receive a huge bolus of new faculty lines due to enrollment growth, we made the critical decision to hold back 18 lines for a new investment in genomics to create the Carolina Center for Genome Sciences, with faculty appointments from seven different academic units representing over 15 departments and disciplines. To chair a new department of genetics in the School of Medicine, we recruited Terry Magnuson from Case Western Reserve University. He brought with him his 15-member research group, and 10,000 mice. Magnuson is a pre-eminent geneticist who could have gone anywhere but chose Carolina because he was attracted by the idea of creating a really big center. Candidly, another part

of the attraction was the fact that we promised him a building. Ultimately, we built two massive research buildings, with still two more on the way. Terry now helps us recruit new faculty telling them, “these people make promises, and they deliver. They keep their word.”

What are the lessons from this experience that I can pass on to you as principles? First, physical facilities matter. We are, indeed, in an arms race of facilities, and the best faculty will migrate to the places that provide them the tools to do their best work. That means state-of-the art equipment. But it also means flexible space that is well designed to maximize human interaction. We designed our buildings with connecting bridges and with meeting spaces and break-out rooms along the corridors and even in the bridges to encourage and facilitate the occasional “ah-ha” moments that sometimes lead to creative breakthroughs. Our goal was that this science complex (which is still under construction ten years later) would allow one to walk through all the science departments in the College to the health science schools in one continuum.)

The corollary principle, one that I articulated in 1997, is: faculty have to be recruited in clusters, not one at a time. The really big questions cross all the traditional boundaries. This means that departments can no longer exercise complete autonomy over hiring. I don’t mean to suggest a totally top-down process for hiring decisions, but rather a negotiated process involving the provost and the top leadership.

To pursue such a strategy requires a plan, an architecture for strategic

investment. Once I had the leadership team in place, I charged the provost with the development of an academic plan, which we adopted in July, 2003. A good plan needs to be specific enough to include concrete action steps, assignment of responsibility and a mechanism for measuring success. It also needs to be flexible enough to allow for opportunistic adjustments as the environment evolves.

Building Public Support

As I think back about my eight years in the chancellor’s office, I am struck by how much of my time and effort was devoted to building public support for the university’s research mission. We learned much from the successful campaign in the fall of 2000 to pass the higher education construction bond. We learned that there was a large reservoir of support for the university among the people of North Carolina. They loved us, but they knew very little about what we do or how we contribute to the betterment of their existence, other than the education of their sons and daughters. That told us we had some major work to do in telling our story.

That also translated into problems we had in the state legislature. For years, the state and/or the university system had been reducing our state appropriation by a percentage (up to 25%) of our federal F&A receipts, with the mistaken view that the campus was adequately compensated for its conduct of research, and these state funds constituted “double dipping.” (This, of course, reflects a total misunderstanding of the inadequacy of the federal F&A rate, which needs no discussion here.)

I helped our Board of Trustees understand how critical reversing this practice was to moving forward the university's research agenda. We had an urgent case in the construction of the science complex, where a portion of the first phase was going to be shelled-in without additional resources. (The state had included a private fund-raising component for every one of our projects that received the total \$525 million in bond funds.) We needed to build out the shelled space in order to retain a key faculty member who was being heavily recruited by several other universities, but we had not yet raised the private funds. We devised a plan to finish the space by using F&A funds to back-stop future private fund-raising. But that plan would fail, if the state, in effect, took part of our F&A away.

Our board mobilized and formed a political action committee, which in a short period of time became one of the most powerful political lobbies in North Carolina, the second largest political action group in the state. The PAC's existence and effectiveness were not always appreciated by the system administration and board, and it was regularly attacked in the editorial pages of the local press as it grew more and more powerful.

The PAC quickly made a legislator's position on F&A retention as the proxy for being a friend of Chapel Hill and thus meriting the PAC's support. Gradually, the climate on our retention of F&A receipts began to change. I recall the first time I had to testify before a legislative committee, facing open skepticism about our plans for using

F&A receipts to leverage research growth.

I decided to try to disarm them with a little self-deprecating humor saying, "Proteomics, Genomics, . . . all these "omics." What do I know about them? I'm only a humble village organist." This seemed to work. They smiled and relaxed and began to listen. The point I really wanted to make is that we intended to use F&A receipts, including anticipated receipts on future research, as front-end cash to build out our research facilities, to back-stop anticipated private fund-raising.

Fortunately, over time, we began to win those arguments. While I would like to think it was the force and logic of our argument that won the day, I cannot discount the political power of the PAC. However, it was not all brute political force. Gradually, we began to succeed in connecting research to economic development, a powerful argument for state support. We marshaled the support of the major private sector research-based firms in Research Triangle Park, many of which had their origins in university-based research. The CEOs of these firms contributed directly to the PAC and they spoke up for us in the legislature.

Gradually, we turned the tide on F&A receipts, and in a couple of years there were no more recorded votes on UNC's F&A receipts. We were free of any state or system control with regard to their usage, allowing us to use F&A funds to finish space in the new science complex that would have otherwise been shelled-in, creating research space that enabled us to win a fierce battle to retain a key scientist. With this

dedicated space and about ten new faculty lines, we established a new Institute for Advanced Materials, Nanoscience, and Technology. I recall that the year we did this, 2002, was a particularly difficult year, in which we were facing budget cuts, and I took some political risk in making such a bold move in an otherwise down year. In my State of the University address in September, I said this:

Some will argue that we cannot afford new initiatives in the current environment. I would respond that, while we must be very judicious in taking on new projects, we cannot afford not to build on our strengths to be the very best that we can be. I think we should all agree on one thing – that we will start nothing that we are not willing to support sufficiently to make it a top-10 program within a reasonable period of time. We must be willing to pull the plug of life support on new programs that fail to meet that threshold.²

This was an investment that paid off. Within five years, UNC was in the top ten nationally based on NSF funding in this area, competing with universities all of which had big engineering schools.

Between 2000 and 2009, UNC plowed \$43 Million in F&A funds directly into research facilities, and another \$90 Million into debt service on research construction with an asset valuation of \$236 Million.

What began as a defensive strategy to protect our F&A receipts gradually evolved into a continuing program of advocacy for the university and its research enterprise. By the end of my tenure, we were coming to the end of the funding stream from the Higher Education Construction Bond, and yet

our needs and aspirations had expanded. Also, by this time, we had established strong relationships with the political leadership in the North Carolina Senate, who had become strong supporters, some would say patrons, of UNC's research enterprise. In fairly rapid succession, the North Carolina legislature funded a new UNC Cancer Hospital (\$180 M), a new research building for the School of Dentistry, and a bio-medical imaging building (\$350 M), the last in a year when there was no other capital construction funding anywhere else in the state. However, the most stunning demonstration of the legislature's support for UNC research was the appropriation in 2008 of \$50 Million in continuing funding for cancer research. UNC is effectively leveraging that funding stream to increase its funding from federal sources.

The point to be made here is the importance of building public and political support in our respective states for the research enterprise of a public research university. We should capitalize on our status as flagship institutions and make the case to state policy makers that we are the principal drivers of innovation that leads to economic development and job creation. This case is easier to make today than it was ten years ago. **We should never apologize for being research universities; we should never apologize for research, but rather celebrate it and find ways to connect our research to people's lives.**

One of the clearest paths of connection to people's lives is through our educational outreach programs. At UNC, the Morehead Planetarium and

Science Center has long been the center of our outreach for children and youth. One out of three North Carolinians under the age of 18 has visited the Morehead on campus. Thousands more have benefited from the “science bus” that takes hands-on science experiences to North Carolina high schools. Next fall, the Morehead will sponsor a two-week state-wide science festival, with over 400 events in 100 plus locations across North Carolina. Our goal is to put the spotlight on science, to do for science in the 21st century what state fairs did for agriculture in the 20th. We believe that this is a model that can be adopted by other states, and we are inviting people from other states to come as observers. While this is not designed as a public relations tool, we believe this festival can have a powerful effect in building public support for what we do.

The North Carolina story is one that can be replicated in other states. **Strong state support can leverage strong federal support and strong private support, and vice versa. Each of these is mutually reinforcing of the others.**

Public Support for Faculty Salaries

If there was a single thread that ran through all of my public presentations during my tenure, it was **the importance of faculty salaries**. We made faculty support the number one priority of the Carolina First Campaign, creating 225 endowed professorships. It was also the centerpiece of our legislative efforts as well.

I convinced the Board of Trustees of the importance of recruiting and retaining the best faculty as the centerpiece of all we were attempting to

do. They got it. The PAC got it, and they were enormously helpful. Once we won the F&A battle, faculty salaries became the issue.

I won't belabor this issue, because you all understand the importance of faculty support to furthering the research agenda. The point I want to make here is that this is an argument that you have to win with the public and with policy makers.

We fought this battle on three fronts – in the legislature, for state appropriations; with the system over the right to raise tuition when the state was unable to provide salary increases; and as the centerpiece of the fund-raising effort.

I used to say that we wanted to have a faculty that the University of Chicago wanted. The trouble is that the University of Chicago (and their several peers) came calling. In 2003, we discovered that we were losing two out of three contested counter-offers. This was a clear path to mediocrity. It was a crisis. We were at a difficult time in terms of state support, with several years of little or no increases in faculty compensation.

North Carolina has a long tradition of low tuition coupled with generous state support. When that support went into decline, however, it was critical that we turn to tuition as a funding source for faculty salaries. We succeeded in getting authorization from the legislature to increase tuition and to keep those funds on campus for faculty support and need-based student aid. Simultaneously, we created the Carolina Covenant program, which guaranteed all students at or below 200% of the

federal poverty level, a debt-free graduation. This program became a national model.

Even with these safeguards in place, I still had major battles with the system Board of Governors, which had little sympathy for the plight of its flagship research campus and no understanding of the competitive environment for research universities. Once again, the PAC came to our rescue, convincing the legislature to overrule the system board. Perhaps my most telling argument to them was the fact that UNC faculty across the university averaged \$211,000 in external funding, while the average salary was about \$165,000. Talk about a return on investment, this was it!

Three years later, as a result of salary increases funded largely from tuition sources, we had reversed the negative trend, winning two out of every three contested retentions. By the time I left office, after two very good years of state appropriations, UNC's faculty salaries, by rank, were higher than either Michigan or Virginia, and only slightly behind UC Berkeley and UCLA, our four major national peers. This was a key part of our overall strategy, and I am convinced our success with regard to faculty compensation was directly related to the success of our research effort. The run-up in research funding at UNC is an impressive story. External research at UNC increased from \$375 Million in 2000 to \$716 Million in 2009, and as of June 30, 2010, has just crossed the \$800 Million threshold.

Vision

In 2003, when the NIH Roadmap initiative was first announced, we commissioned a team of our best

scientists, some of whom had just been recruited in the early wave of faculty appointments, to plan for the Roadmap, which itself, would map the future of NIH initiatives. As a result of this initiative, UNC led the nation with the number of Roadmap awards in the first year and again in the second.

We were totally opportunistic in this case. We were fortunate that our strengths mapped well with where we thought the NIH wanted to go, and we put major resources into place in order to be competitive.

Given the investment the state was also making in research infrastructure and, later, direct research support, we could leverage each of these elements constructively.

Here, perhaps, I can derive another principle. **To be successful in big science, institutions need to think strategically, placing bets by allocating resources where there may be a big return.** This requires a certain degree of central planning, just as we did with the NIH roadmap. To be sure, a successful university will always have a balance of individual PI grants and some big team-based grants. But the major leagues are dominated by the latter, not the former. This requires us to be brutally honest about our capabilities. There are some big opportunities out there that we simply do not have the resources to address. No amount of incremental funding would matter. We have to be willing to say no to investment in such ideas, attractive as they may be to one or more advocates. *This is a critical point. Great universities do not dabble in areas where they lack strength or competence. It is important to know when to say no, to have*

the courage to say it, and to stick with your decision.

In 2006, in my fall State of the University address, I hit the campus with a blockbuster. With external funding at just short of \$600 Million, I proposed establishing a goal of \$1 billion in external funding by 2015. I arrived at this number in close consultation with Tony Waldrop, the vice chancellor for research, who assured me that, while this was a huge stretch goal, it was not impossible. This is what I said:

Let us be crystal clear about this: \$1 billion is a stretch goal, more than \$200 million above what we might be expected to reach at our current trajectory. Some have argued that this is too high ... unrealistic ... that the uncompensated cost of this research will be unaffordable. To use a Jim Collins term, this is a "big, hairy, audacious goal," appropriate for a university aspiring to be the leading public university. We should dream no small dreams.³

Sometimes it is important for a leader to lay out something like this, without the assurance of success, remembering that big goals carry with them the high risk of failure. Just as I did not have absolute confidence in my promise in 2000 that we would triple the people's investment in the bond issue, and I am not certain that UNC will reach this goal. But I am certain that it is on a positive trajectory to do exactly that, and, in my opinion, that is all that matters.

I believe that this is one of the major responsibilities of leadership – to set a vision, and to be the principal cheer-leader for that vision.

Over time, I discovered that one of the things state policy makers could

quickly grasp was the connection between research, tech transfer, and job creation. When I arrived in Chapel Hill, UNC had a dismal record of creating spin-offs; the tech transfer office was seen as a barrier, rather than a bridge; the institutional culture was anything but supportive of entrepreneurship. We worked hard to change that culture.

My partner in this effort was Tony Waldrop, the vice chancellor for research, whose title we changed to *research and economic development*. We beefed up the tech transfer office, brought in new leadership, and we listened to our most entrepreneurial faculty about what they wanted and needed. I made a key change in the Office of General Counsel, another office that was seen as a major obstacle.

Over time, we saw a complete transformation of the culture for tech transfer from negative to positive. In 2004 UNC received one of seven grants in a national competition from the Ewing M. Kauffman Foundation to embed entrepreneurship into the curriculum. By placing this new program as an undergraduate minor in the College, not in the Business School, we were able to impact the entire campus. As a result, today we have programs in social entrepreneurship, and artistic entrepreneurship, not just the usual suspects from science, technology, and the health professions. The culture really did change.

However, as I left office in 2008, I could still occasionally hear complaints from our faculty about the pace of tech transfer. We still were not where we needed to be for our most ambitious faculty entrepreneurs. In December,

2009, Tony Waldrop and his colleagues announced a real breakthrough, that Cathy Innes, UNC's director of the Office of Technology Development, called, "the Holy Grail in technology transfer transactions – the standard license agreement."⁴ The Carolina Express License⁵ offers the same terms to all UNC start-ups and offers the best deal available from the University, covering a widely divergent stream of deal-flow with minimal negotiation. I can't claim any credit for this development, which occurred after I left office, except to say that it all started with a fundamental policy shift to be an entrepreneurial university. In my opinion, this is where research universities need to be, especially public universities. That is at least a part of our reason for being as servants of society.

This focus on economic development and job creation needs to be kept in focus and in balance. It is a hand that can easily be overplayed, and this is a trap that must be avoided. It cannot become the only metric for success. There is a second trap here that is especially tempting for trustees, and that is to make the funding stream from licensing fees the goal. Everybody wants the next Gatorade. The new Carolina Express License actually makes concessions on this point, sacrificing some short-term financial return in favor of more rapid spin-off creation.

Finally, I must speak about the arts and humanities. I am personally sensitive to this area, because it is my own. I was acutely aware that in my first five years at UNC, much of my time and energy was spent on big science, medicine, and technology. These were

areas of critical concern and major opportunity.

However, I was also aware of the fact that I presided over a university with a distinguished history in the arts, humanities, and social sciences. In fact, one of Carolina's strengths was the balance among each of these major areas. I regarded that history as a treasure that I was determined to preserve and protect.

One of the early decisions that Provost Shelton and I made together when the budget cuts began early in the decade was that, at all costs, we were going to protect the library. Not the serials budget, but the acquisitions and operations budget of the library.

As time passed and our position became more and more secure, we turned gradually to providing more direct support to the arts and humanities. We made a major investment in the performing arts presenting program, for example. We made sure that some F&A resources were directed to small grants programs for faculty in the arts and humanities. We went out of our way to celebrate individual faculty accomplishments – election to one of the national academies, appointments to endowed chairs. We raised some serious private money to support these areas.

Here is the principle I want to evoke: A great research university must maintain a balance, an equilibrium, between those areas that garner major external funding, and those that never will. Core areas of strength in key areas of the arts, humanities, and social sciences must be maintained. This requires a certain sophistication in the

internal funding model, openness and transparency in the flow of funds, but above all, the strength and courage of top leadership to do what is necessary to support faculty research and creative activity in these areas.

Let me conclude, by simply summarizing the basic principles I have outlined in this paper, going back to my 1997 presentation.

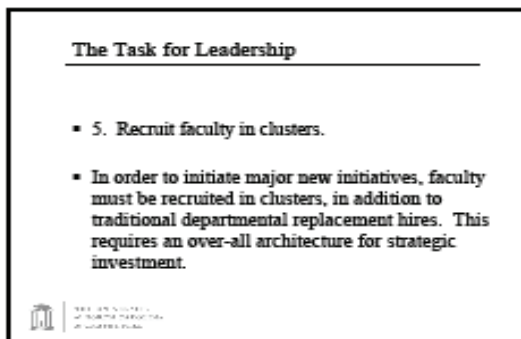
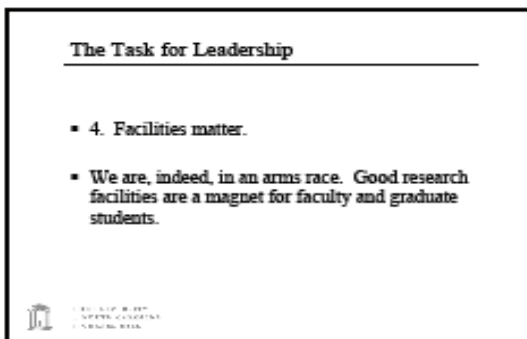
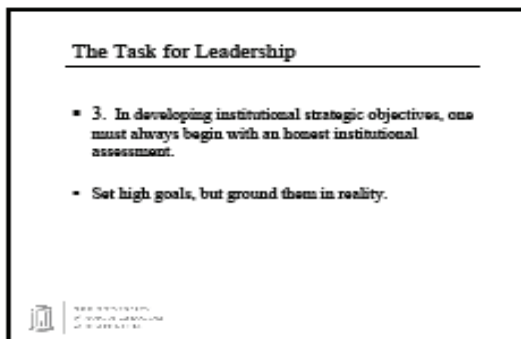
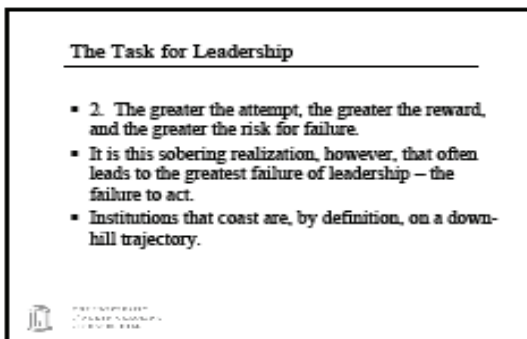
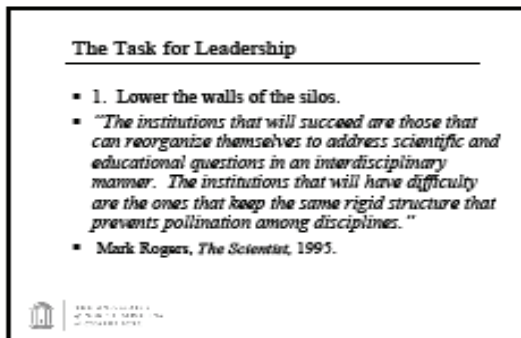
- Lower the walls of the silos to facilitate inter-disciplinary work. Create inter- and multi-disciplinary research clusters to address large problems.
- The greater the attempt, the greater the reward, and the greater risk for failure. Fear of failure often leads to the greatest failure of leadership – the failure to act.
- In developing institutional strategic objectives, one must always begin with an honest institutional assessment. I strongly believe in setting high goals – big hairy audacious goals, but those goals need to be grounded in reality.
- Facilities matter. We are, indeed, in an arms race. Good research facilities are a magnet for faculty and graduate students.
- Faculty have to be recruited in clusters in order to create major new initiatives, in addition to traditional departmental replacement hires. This requires an over-all architecture for strategic investment.
- Strong support from the state for research can leverage stronger federal and private support. We must never apologize for research, but rather celebrate it

and find ways to connect it to people's lives.

- Public support for faculty compensation is vital. Faculty compensation is the most critical area of national competition. Everything hangs on the quality of the faculty.
- To be successful in big science, institutions need to think strategically, placing bets by allocating resources where there may be a big return. The major responsibility of top leadership is to set a vision and to be the cheer-leader-in-chief in articulating that vision to the university's many constituencies.
- A culture of entrepreneurship is a critical value. Success in economic development and job creation is the best argument for continued support for research. Avoid the traps. Don't overplay this hand. This must not be the only metric of success. The funding stream from licensing is not the goal.
- A great research university must maintain a balance, an equilibrium, between those areas that garner major external funding, and those that never will. It is a primary responsibility of top leadership to maintain areas of strength in key areas of the arts, humanities, and social sciences. *This takes vision and courage.*

References

1. Mark Rogers. *The Scientist*. 1995
2. James Moeser, State of the University Address, September 4, 2002
3. James Moeser, State of the University Address, September 6, 2006
4. "UNC unveils innovative new licensing model to spur business spin-offs," UNC press release, December 10, 2009.
5. <http://www.desimone-group.chem.unc.edu/the-news/144-techtransferpapermakestop10-download-list>;
<http://uncnews.unc.edu/content/view/3174/103/>



The Task for Leadership

- 6. Strong support from the state can leverage stronger federal and private support.
- We must never apologize for research, but rather celebrate it and find ways to connect it to people's lives.



The Task for Leadership

- 7. Public support for faculty compensation is vital.
- This is the most critical area of national competition.
- Everything hangs on the quality of the faculty.



The Task for Leadership

- 8. To be successful in big science, institutions need to think strategically, placing bets by allocating resources where there may be a big return.
- The major responsibility of top leadership is to set a vision and to be the cheerleader-in-chief in articulating that vision to the university's many constituencies.



The Task for Leadership

- 9. A culture of entrepreneurship is a critical value. Success in economic development and job creation is the best argument for continued support for research.
- Avoid the traps. Don't overplay this hand. This must not become the only metric of success.
- The funding stream from licensing intellectual property is not the goal.



The Task for Leadership

- 10. A great research university must maintain a balance, an equilibrium, between those areas that garner major external funding and those that never will. It is the responsibility of top leadership to maintain excellence in the arts, humanities, and social sciences. This takes vision and courage.



Lingchi and the Modern Research University

Harvey Perlman

Chancellor, University of Nebraska-Lincoln

I am accustomed to following James Moeser. He was my predecessor as Chancellor at the University of Nebraska-Lincoln and that has allowed me to take credit for many of the things he initiated. Similarly, today I am positioned to build on, or to entirely appropriate, his ideas although as an audience you will instantly know when I am doing so.

The last time I attended the Merrill Retreat was in 2004. At that meeting I reviewed the strategies and techniques we had used to address a 12% budget reduction over a two year period. I was struck by my tone of relief, in that we had seemed to address the challenge, had in many ways strengthened the university, and were well positioned to move forward. Little did I know that it would not be the last time the university would face a budget challenge, or that six years later I would be doing a reprise of those remarks.

My paper is entitled “Lingchi and the Modern Research University” and for those of you neither fluent in Mandarin nor agile with Google, Lingchi is an ancient form of Chinese torture in which small pieces of flesh are slowly cut from a person’s body over an extended period of time. The practice of Lingchi was reserved for particularly egregious crimes and became the source for the phrase “death from a thousand cuts”. In this audience I don’t need to be explicit about the analogy to what we as public universities have experienced over the last few years, or what it appears we may experience in the future. I have been asked to describe the situation at the University of Nebraska-Lincoln and our thinking as we move forward. I will try to avoid whining. At least from my perspective, public universities are not being singled out for harsh treatment, nor have they lost the respect of our constituents. We are

among the many public services feeling budget restraints in an era where there is little taste for raising taxes.

The University of Nebraska-Lincoln

Over the course of the last decade during the period when I’ve been Chancellor, we have been asked to address seven different budget reductions. In only one of those years was the budget we received from the state actually less than the year before. In all other instances, the state was unable to provide the funds necessary for increased expenses, including salary increases, so we reallocated existing resources. With the exception of 2003-2004, these reductions were modest and manageable. During the 2003-2004 period we were forced to take fairly dramatic action including some outright academic program eliminations and the termination of tenured faculty. Since then, for the most part, we have reduced

our administrative expenses through efficiencies and we have reduced academic expenditures through restructuring, some tangential program eliminations, and some reduction in faculty and staff positions.

Based on our metrics and, I think, on the tone of our campus, these reductions did little harm, except to the individuals directly affected, and in many ways strengthened the university. Since 2001, through all of these reductions, enrollment has increased by over 2,000 students, our graduation and retention rates have significantly improved, our percentage of non-resident students has increased from 11% to over 23%, the academic credentials of our entering class are the highest in the history of the university, and our research productivity has more than doubled. We think we detect a renewed sense of ambition and commitment to excellence among our faculty and a very elevated level of expectation for our success among the business and political communities of Nebraska.

Throughout we have had two priorities—undergraduate education and research—and we pursue them when making both investment decisions as well as reduction decisions. We are focused on getting the best team of people in place, whether in the administration or the faculty. As you all appreciate, nothing good happens without good people. And we have been blessed with good people. I would single out Vice Chancellor Prem Paul whose energy and enthusiasm has contributed significantly to our research success. But you can't do it without luck and

resources. The luck and resources came together when an elderly couple passed away leaving the University a largely discretionary bequest of \$128 million. James Moeser, in one of his most significant decisions, allocated a sizeable portion to a pool from which subsequent gifts by others for endowed professorships would be matched. We now have some 24 of these elevated professorships and, in almost every case, they have been used to attract a mid-career faculty member with a strong research agenda.

I can't help but mention that we continue to believe that our spike in enrollment, particularly non-resident enrollment, can be traced not only to the hiring of an experienced Dean of Admissions, but also to the NBC film "Tommy Lee Goes to College". Six hours of prime time network television devoted to our campus made a lot of students see we weren't a couple of buildings in the middle of a corn field, notwithstanding that it probably took years off of many of our lives as we waited to see the final product. I was reassured when, off camera, Tommy looked me in the eye with full sincerity and said: "Chancellor, I will never do anything to embarrass you or the University" until I realized he would have no idea what might embarrass me or the university.

I want to mention two major achievements during this period that position us for the years ahead. First was having the faculty of the academic colleges adopt a simplified general education requirement, called Achievement Centered Education, that is built on assessment of outputs rather

than counting inputs and facilitates our undergraduate students' path to graduation. The second was convincing the Nebraska Legislature to move the State Fair from its 100 year home adjacent to our campus so that we could create an Innovation Campus. Our plan is to use these 250 acres to leverage our research success to drive economic development, by attracting private sector companies who are engaged with us in research and other activities to locate on the property.

During the most recent recession, Nebraska has been relatively insulated. A combination of conservative budgeting and a strong agricultural economy based in part on ethanol has allowed the University to avoid massive budget reductions and we still receive approximately 30% of our general operating budget from the State. However, as we look toward the next biennial budget for 2011-2012, the clouds are very dark. Tax revenue has recently come in under estimates and there is a projected budget deficit, including loss of the stimulus funds, of between \$600 million and \$1 billion for the next biennium. In short, we do not think we are done with budget reductions and we have tried to do what planning we can to prepare.

Future Strategies: Instructional Costs

I do not think a university can continually "cut itself to excellence". Lingchi is not a recipe for success. But as university officials we have little choice but to deal with the cards that are dealt us. Going forward, we really only have two choices: we can continue to do what we do with less resources—that is

become more efficient, or we can find additional sources of revenue—that is become more entrepreneurial. Either approach presents risks to the core values of higher education, but failing to do either may present even greater risks.

With respect to the University of Nebraska-Lincoln, we continue to focus on undergraduate education and research as our two top priorities. Because our state supported budgets are the primary source of revenue for the instructional mission, the pressure in times of budget reductions falls primarily on the teaching enterprise. And thus, the pressure to make up for reduced state support falls heavily on tuition. In our case, the University is committed to affordable access and, even though we have a comparatively low tuition structure, it is unlikely that we will be able to raise tuition sufficient to compensate for any cut of state resources. At UNL, for example, a 1% increase in tuition represents about \$1.2 million whereas a 1% reduction in state support represents a loss of approximately \$2.5 million. A general tuition increase beyond 6% per year would be politically difficult.

One can increase tuition revenue by increasing enrollment. Fortunately, four years ago our system office adopted a budgeting policy that allows each campus to benefit from the tuition they generate. Beyond intensifying our efforts in recruitment, both within and outside Nebraska, we see at least three additional sources of enrollment growth. The University has made a substantial investment in on-line education, as have many others, and we continue to see increasing students and increasing

revenue. Over the last 4 years UNL has also sought to attract more paying foreign students. We have tried to be a bigger player in the Asian countries where there remains a significant tradition of 2 + 2 programs—programs specifically designed to allow Asian students to study in their own country for the first two years and transfer to an American university for the last two years.

UNL has opened offices in Xian and Hangchow China at two universities under partnership degree programs where we have university staff assisting in advising, English language instruction, and recruiting students. This Fall will be the first test of how attractive this program can be and we expect over 100 Chinese students from these programs to enroll. We also recently re-energized our relationships with universities in Singapore and Kuala Lumpur. In the past we averaged 400 Malaysian students, but that number has fallen due to our neglect. We have chartered two alumni chapters in these cities and now have a group of alumni anxious to help us recruit students. As the Asian countries continue to develop their own higher education systems, these programs may be less attractive from their point of view. During my visit this Spring, we were receiving pressure to develop 3 + 1 programs and even 4+0 programs—where we would offer the last year or two of our academic program but in their country. Such programs will raise difficult questions beyond whether they can be cost effective.

Internally the conversations on enrollment growth are more difficult

because the tradition is always to focus on the additional resources required to accommodate more students. One of our challenges is that units which currently have teaching capacity probably do so because of reduced demand for that discipline and those units which have opportunities for enrollment growth are probably fully subscribed. Moreover, under the traditional model, the investments needed to accommodate enrollment growth in one discipline produce externalities in others. One might carefully calibrate how many new faculty are required for 100 more students in a program like, for example, nutrition, by considering the core curriculum, laboratory instruction, etc. However these students also put pressure on the English Department and other departments. Our standard thinking requires us to apply the theories of quantum physics. Very small increments might be accommodated within existing resources, but to justify increased investments the enrollment has to take a quantum leap forward.

I have said this is traditional thinking. It assumes a number of things about the status quo. It assumes teaching loads and class sizes are static. It assumes the scheduling clock and calendar are immutable. It assumes the curriculum is written in stone and the current teaching methodology is sacrosanct. Let me emphasize there are good and sufficient reasons behind the traditional thinking—ones I can easily defend. However, it may be that there are changes that could produce more benefit than cost—changes that we would legitimately ignore except in the current circumstances.

During the last couple of years of strategic planning exercises I have suggested to our Deans that if they would provide me a business plan that showed a positive cash flow between additional investments and increased enrollment, I would make the investments and allow them to keep a significant share of the revenue. We may enter a time where I might have to say to a Dean: "I am cutting your budget by x amount unless you increase enrollment by Y students." My best guess is that clever deans would be able to manage.

There are a variety of tools at their disposal to do so. None of them necessarily enhances the quality of the learning although there seems to be preciously little research to suggest they would reduce the quality either. But, in this world, perception may be everything. In any event, here is a list of things to consider:

Professors of Practice. At UNL we adopted this faculty status several years ago that allows individuals who wish to engage in full-time teaching rather than in research to be hired with professorial rank. They work under contract and not tenure.

Differentiated teaching loads. The era of the standard teaching load on the assumption that each faculty member is also doing research is certainly at risk. We have often assumed in research universities that all faculty fit the criteria of our ideal: the gifted teacher who also conducts cutting edge research, and also engages in a variety of ways with the community. But if truth be known, focusing existing faculty members on their strengths may produce significant

efficiencies, as well as being consistent with modern personnel theory.

Differentiated teaching methods. How large do classes have to become in order to be of significantly lower quality, if at all? Can the faculty of your and my generation adjust to the biological clock of this generation so we can start offering crowded classes after midnight, a time my observations lead me to believe that is some students' most productive time? Can some of the routine instruction be more efficiently conveyed through information technology? Can we outsource some of our curriculum?

These are all difficult steps for any of us to contemplate and they would not elevate our career aspirations as Presidents or Chancellors. It is, in some respects, much easier to increase the tuition rate, where the primary issue is how much to discount the nominal price to maintain enrollment levels. The political pressure against increased tuition, at least in Nebraska, is intense as families, legitimately, worry about their ability to finance their children's education or alternatively worry about whether their children will be able to finance their own education out of future income streams.

How could we alter this environment in productive ways? If the issue were only a financial one, we might increase tuition but shorten the time required for graduation. We could in affect share with the student the savings in costs of attendance and the opportunity costs of delayed employment. Could we structure a curriculum and a financial aid system

that would allow us to charge higher tuition for a more intense experience?

Another way to adjust the tuition rate is through differentiated tuition. There is no question that the costs associated with different disciplines is differentiated. And at UNL we have not had difficulty differentiating between programs at the graduate and professional level. There remains, however, a traditional theme of trying to facilitate student choice at the undergraduate level by removing financial considerations. As the argument goes, a student shouldn't have to choose between Engineering and English based on cost factors. Of course, the engineer is likely to have considerably higher life time earnings than the English major and it may not be a bad lesson that few choices in life come without costs—either upfront or long-term. In any event, it seems likely that differentiated tuition will be part of the landscape of higher education as we go forward.

Research Costs

At the local level, the narrative of the Lingchi practiced on our public universities involves the struggle between tax dollars, tuition levels, and program reductions. The narrative is more nuanced with respect to the research mission, and perhaps more internal. In Nebraska, as in many states, the growing importance of innovation to economic prosperity is increasingly apparent and increasingly accepted as a matter of political faith. The Nebraska Legislature with the support of the Governor overwhelmingly voted to move the State Fair, notwithstanding some fairly highly pitched opposition

voices and the business community has strongly supported our research efforts as a key to economic growth. However, in this environment, the State has been unable to make the kind of investments necessary to sustain the University's capacity for research. Without major investments in facilities and instrumentation from the State, we have had to rely on creative financing and philanthropy to sustain our momentum.

As public dollars become more scarce, I see two sources of increasing frustration within our institutions. First, the inherent tension between teaching and research may escalate. As we differentiate and increase teaching loads, expand class sizes, and in general raise the expectation of effort on the part of faculty who teach, it may appear that we are emphasizing research at the expense of teaching. I don't see these two missions as separate or in competition, but I continue to hear the complaint on the ground. Certainly we have put more pressure on our research faculty to produce and in many respects they, more than their teaching colleagues, are forced to eat what they kill.

The second source of frustration was well framed by one of my AAU colleagues who said we were entering a time in the research enterprise where opportunities will expand, but the resources will not be available to exploit them. He was referring, I think, to the concern about support for funding research capacity—both at the state but also at the federal level. The primary issue here is the tendency at the federal level to limit or reduce the reimbursement for Facilities and Administrative costs associated with

federally funded research projects. Both the AAU and the APLU have developed papers designed to urge the federal agencies to continue to provide these reimbursements—to support as a recent draft AAU paper suggests, the historic partnership between the federal government and research universities by funding the “full costs of research.”

The system of F & A reimbursement is not well understood, either among our local constituencies or the federal government. We often have to answer questions from state officials about why the state shouldn't receive the F & A reimbursements since the state bore the costs in the first place. And there is constant pressure from our faculty to reduce or eliminate the F & A reimbursement in order to make their grant submissions more attractive. And from Congressional and other federal sources you hear the argument that these reimbursements actually detract from the total amount of research that can be conducted. Similarly, many private Foundations and state agencies refuse to pay full F & A reimbursement.

We have not done a good job of justifying the F & A reimbursement system. One cannot talk about a “partnership in research” between the Federal Government and research universities and then ask for “full reimbursement” for the costs of research. That is not much of a partnership.

From the granting agency's perspective, the issue becomes how to use a limited resource—the agency's research budget—to produce the maximum amount of research over time. Incorporating F & A reimbursement in a

particular grant does reduce the amount of research the agency can fund in any grant cycle. To the extent there are real, un-reimbursed costs in a particular grant, those costs are redistributed to the University. Indeed, it is my understanding that the limit on F & A imposed by USDA is based on the assumption that the costs of agricultural research should be shared—thus, arguably, expanding the amount of research that is conducted.

Properly understood, I think this is an incomplete analysis of what is required for a research enterprise in this country that can be globally competitive. Even with “full” F & A reimbursement, the universities would bear a considerable share of the cost of the enterprise. The most significant cost is creating and maintaining the capacity to perform research. A national initiative toward innovation requires the continual generation of a pool of human talent from which good ideas can flow. Increasingly our undergraduate programs as well as our graduate programs are designed to induce young men and women to be attracted to the process of innovation. In assembling a faculty, universities are creating a pool of talent available to pursue the research enterprise. In addition to the costs associated with this assembly process, the university bears the full risk associated with obsolescence. A federal granting agency can easily shift its priorities; universities cannot. Today we are all attempting to build strength in nanotechnology and the variety of “omics” that drive the life sciences. To motivate faculty members to specialize their intellectual pursuits and foreclose

other opportunities we grant them tenure or other forms of security, and offer them start-up packages of specialized facilities and instrumentation. We bear the significant risk that the future may make these specialized investments irrelevant.

As basic research has moved from the private to the public sector because of the risks that cannot be managed by capital markets, most of these risks are shifted to universities. Certainly the funding of basic research represents risks for the granting agency. However, in this competitive market, applicants are increasingly required to move their research further along the spectrum of certainty in order to obtain funding. Universities continue to be the primary funding source for the early stages of curiosity based research.

Thus the university's role in the research enterprise seems to me to be evolving into bearing the most significant and uncertain risks associated with innovation—risks that must be borne if this country is to remain competitive. All of the resource pressures facing public universities continue to erode our ability to bear

these risks. To sustain our research enterprise we increasingly seek partnerships with private sector companies whose tendencies are to push us further toward the applied end of the research spectrum.

Conclusion

While the caricature of a university is that of an institution where change comes slowly if at all, I remain confident that research universities will continue to adapt and evolve as external resource constraints require. I remain optimistic that deep in the American psyche there is an understanding of the importance of the research university to the country's survival.

The Chinese abandoned Lingchi as an official form of execution in 1905. Since then China has grown and prospered. One hopes the United States quickly learns this valuable lesson with respect to the practice directed at American public universities. There are few recorded instances where the victim ever survived Lingchi, although one can hypothesize that those who did were left badly scarred both physically and psychologically. One has to hope this doesn't happen to us.

Response

Bernadette Gray-Little, Chancellor, University of Kansas

I want to get to the discussion section of this morning's session, but before I do that, I would like to offer some of my own thoughts.

Both Dr. Moeser and Dr. Perlman talked about change. Change at their universities, often as a result of actions they took, and change in higher education overall. I think we all agree that much of the change we've seen in the past several decades has been positive.

Access to higher education is greater, especially for first-generation students, women and people of color - enabling them to receive the sort of education once reserved for a more select few.

Our research endeavors are even more expansive, leading to new discoveries, new ideas and new ways of thinking, as well as spurring an even greater rate of change. And the services we provide to our communities are broader - from opportunities in culture and the arts, to medical care for the uninsured.

Of course, some of the change we've experienced has been driven by the simple fact that expectations for public research universities are themselves much higher than they once were. National public research universities are asked to generate and spin off research, train the workforce, drive the economy, enhance quality of life, and keep this country competitive in the world.

That's a tall order. Especially during a time when we're facing new challenges. Some of those challenges are technological, such as the rise of online education. While creating new opportunities for expanded access, it

also has created new competitors and threatens to turn higher education into just another commodity.

Some of those challenges are demographic. States like Kansas - and I would anticipate Nebraska - are experiencing a decline in the number of high school graduates as the population ages. That reduces the traditional pool of potential students.

At the same time, we are seeing growth in the number of Latino students in our K-12 schools. Many of them will be first-generation college students if given the opportunity to attend college, and they will face the same barriers to higher education that all first-generation students face.

And some of our challenges are financial. Chancellor Perlman talked about death from a thousand little cuts. Well, at KU we have had two big cuts over the last two years. I haven't checked to see how to say that in Mandarin Chinese, but those cuts have

totaled more than \$40 million when the mandates are factored in. They're just as damaging as hundreds of little slices.

This situation is faced by research universities around the nation. In many instances their financial situations are more dire than ours. But in every instance, the financial and other challenges we face are calling into question the future of public research universities.

This is an issue we talked about at my inaugural symposium in April. It is one being tackled by AAU, and the APLU launched its Future of Public Research Universities initiative last fall. And at the request of Congress, the National Research Council is also undertaking a study that seeks to answer the question:

"What are the top ten actions that Congress, the federal government, state governments, research universities, and others could take to assure the ability of the American research university to maintain the excellence in research and doctoral education needed to help the United States compete, prosper, and achieve national goals for health, energy, the environment, and security in the global community of the 21st century?"

Not an insignificant question --- but one they intend to answer by May of next year.

In the meantime, each of our institutions is called upon to answer the many challenges I've outlined - as well as others.

Both of our speakers' comments point to the need to focus, to carve out areas of excellence, and to be hard-nosed in setting a course and staying on it. At the same time, there is a need to think

big and be expansive, but to not try and do too many things at once.

That forces difficult decisions, especially when it comes to allocation of resources such as money and time. At KU we are focusing on enhancing the quality of our undergraduate education. That will require us to expect more of our incoming students, but also more of ourselves as recruiters, teachers and mentors. It will also require us to take a hard look at everything, from advising to our general education requirements.

The latter is something I helped tackle at The University of North Carolina, which gives me some idea of the scale of that task. But we have to do these things if we want to ensure more students finish what they start when they come to KU.

We also must address the challenge of graduate education, particularly how we provide funding to our doctoral students that allows them to succeed in the many roles we ask them to take on. Universities demand a lot of them - as teachers, researchers, and students - and don't always give them the proper support in the process.

And we must increase our scholarly output, but not just in research areas that are grant-based. The full spectrum of scholarly and creative activities must be promoted. I share Dr. Moeser's concern about the importance of ensuring that the humanities and humanistic social sciences not be left behind in a drive for research in the sciences that is more easily commercialized.

On this last point - before we can even move forward on increasing our output, we're finding that we have to do a better job of measuring it. Current

measures like grant awards or papers don't give a complete picture. And without a complete picture, we can't identify the departments that need to improve their performance, let alone identify those units that are doing a good job already and can serve as models.

And as we deal with these challenges, we are at the same time seeking to convince parents, students, legislators, business leaders, alumni, donors and others of the importance of public research universities to the future of the nation and the prosperity of our states. I think both Dr. Moeser and Dr. Perlman would agree that it is a surprisingly difficult task.

Some of what we do is easy to measure:

- The number of students who graduate from KU - more than 7,000 a year.
- The amount of research funding we bring in - more than \$200 million a year.
- The research discoveries that lead to new companies - 17 active start-ups in Kansas alone.

Those are easy, but they're just numbers. They don't have the same emotional resonance as the things we do that are not possible to quantify: The lives changed - and the lives saved. The true economic impact of our graduates and our research. What our economy, our nation, or our society would be like without the work we do. Those are more compelling cases, but they're also harder to make.

And in the midst of making those cases, we can still have our voices drowned out by the thrill of a big basketball victory, or the drama of conference realignment. Now - the public still supports higher education and parents still want their children to be educated, though they may want there to be more of a focus on skills directly related to employment, as opposed to education for the sake of being educated - which poses another challenge to liberal arts education.

Yet even in the midst of the recession - we still see the public willing to invest in higher education. Two years ago at the height of the financial crisis, the voters of Johnson County, Kansas took the remarkable step of passing a local sales tax increase dedicated to funding education and research through a partnership with KU and K-State.

We've also seen strong support for our cancer center from the Kansas Bioscience Authority, even during a time when the State has been cutting back. Public support is there, even during a time of reduced resources - though more than ever they expect us to justify their investment.

Universities face challenges - of that there is no doubt. But as a starting point for our discussion, I'd like to ask our guests if they think times are more difficult than usual for public research universities. Is there anything uniquely different and challenging about today? Or are we just facing new versions of long-standing problems?

Building Synergies

Jeffrey Scott Vitter, Provost and Executive Vice Chancellor, University of Kansas

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.

References

1. Boyer, E. L. (1996). The scholarship of engagement. *Journal of Public Service & Outreach*, 1(1), pages 11–20.
2. Florida, R. (2003). *Rise of the Creative Class*. Basic Books.
3. Jorgenson, D. J., Ho, M. S., & Stiroh, K. J. (2005). *Productivity*, volume 3: *Information Technology and the American Growth Resurgence*. Cambridge, MA, DC: MIT Press.
4. Locke, G. (January 7, 2010). Remarks by the Secretary of Commerce to the President's Council of Advisors on
5. McPherson, M. P., Gobstein, H., & Shulenburg, D. E. (2010). *Assuring that Public Universities Remain Vital: A Report to the Membership on the Research University Regional Deliberations*. Association of Public and Land-grant Universities.
6. www.indure.org (April 26, 2010). Indiana Database of University Research Expertise, version 2.0: <https://www.indure.org/>.

Lemons to Lemonade: Finding new opportunities in a challenging time

April C. Mason

Provost and Senior Vice President, Kansas State University

Like many universities, at Kansas State University we have entered into a time of strategic planning. K-State 2025 is the title of the plan and the overall goal has been established. By 2025, Kansas State University will be recognized as one of the nation's top 50 public research universities. The process to establish objectives, strategies and a timeline to achieve these goals has just begun. Focus group sessions were held across our campus to include administration, faculty, students, classified and unclassified staff, and off campus with groups of alumni, business and community leaders, and members of the state legislature.

Benchmarks have been identified to establish K-State's current standing among an established group of peer institutions and, to no surprise related to this conference, the very first benchmark is that of the university's research and development expenditures. To be in the top fifty public research institutions, K-State must increase the amount of extramural funding across the entire campus.

As Provost and Senior Vice President, I have identified a number of strategies to increase research and development expenditures that I share with this group. These strategies will not surprise any in this room; however I do want to highlight the University's unique opportunity with each strategy and describe how I feel these strategies are helpful to all public research institutions.

The strategies I wish to discuss are:

- Diversify funding sources
- Collaborate

- Across campus
- Across universities
- Build on strengths
- Grow where planted
- Be opportunistic
- Hire well

Diversify funding sources: The public research university that will be successful today and into the future must have a deep portfolio of funding sources. Just as we are encouraged to diversify our investments personally, we as universities need to diversify our funding sources. Federal grants are and have been traditionally the key to funding research on our campuses. Keeping faculty competitive in this area is still important. However, finding other funding sources is also essential. State contracts, block grant competitions, foundations, and industry grants and contracts must be added to funding

portfolios. The search for new foundations, new industry partnerships, new sections of federal granting agencies is critical. USDA and NIH have gone through some major shifts in funding and reviewing strategies recently. The landscape of funding is constantly changing. The successful university is the one that diversifies and stays current on funding criteria.

At K-State we have had particular success in the emerging areas of energy and power and of sustainability. New partners, corporate collaborations, new federal initiatives have assisted the faculty of the university to be successful in these areas. Diversify funding sources.

Collaborate: Across our own campuses or across universities in this country or across country borders, collaboration is key. Gone are the days of the single investigator grant. Bringing the right group together can involve multiple people from the same department or campus, or can involve a multidisciplinary team from different institutions and countries. Technology has assisted greatly in making distance collaboration easier.

Recent changes in USDA funding at the National Institute of Food and Agriculture (NIFA) is a great example of this type of deliberate collaboration. NIFA grants are now larger and there is the expectation of larger research scope with multiple partners. NIFA as well as NSF have built into their Requests for Proposals the expectation of educational outreach with the research outcomes of the project. Collaborations between discipline scientists and educational professionals have flourished in this environment.

Funded projects of the future will be collaborations, multi-disciplinary efforts, multi-institutional projects with no room for silos. This type of work is not without

difficulties for our faculty. University officials should be responsive to the organizational needs of large multi-institutional research proposals as the complications these types of projects bring is high. Collaborate.

Build on strengths: The universities represented at the Merrill conference are similar in many ways, but have individual strengths and expertise. Today is the time to capitalize on those unique strengths. How can we make our submissions to funding agencies stand out—by emphasizing the uniqueness of our expertise in the grand marketplace of research expertise. At K-State we have been able to build on and capitalize on the strengths of our veterinary medical area. Infectious disease research around animal health and food safety are clearly areas of particular strength. This is not the only research done on our University campus, clearly, but it is an area we try to market, grow, and build. The investments made in an already recognized strong area are strategic and heighten the status of that area. Build on strengths.

Grow where planted: I don't add this to my list of strategies just because K-State is the Land Grant of Kansas and has the Agriculture College, I add it because there are unique opportunities each of us can enjoy solely as a result of where we are physically located or where we have historically invested. For K-State I would like to highlight a number of strengths that arise from both place and historical investment. When one thinks of agriculture in the state of Kansas, it does not take long to think wheat and beef. K-State has built on those areas to become national and international leaders. With the strong wheat industry in Kansas, collaborations with wheat growers, milling of wheat, testing of

baking quality in developed wheat varieties and tolerance to weather conditions have been pivotal research areas. In the beef area, the research of the Beef Quality Institute faculty and staff is in the area of safety and quality of beef products. These two areas of agriculture are essential to the economy of the state. Partnerships with the industry, industry organizations, state agriculture and local producers are key to a sustainable crop and animal production system.

The military presence in the state of Kansas is a valuable resource for our universities. K-State works with Fort Riley, Fort Leavenworth, and McConnell Air Force Base. McConnell Air Force base has Cooperative Extension programming provided on site. At Fort Riley there is a Cooperative Extension presence with an office and staff located on site. Work with Fort Riley leadership and military families has led to the development of the Military Families Institute. Long deployments, multiple deployments, injury and recuperation puts strains on families never before experienced. Faculty, staff and students work to assist military families maintain strong communications, identify helpful resources and be assured they are not alone in their situations.

Educational programming at Fort Leavenworth includes Adult education master's and Ph.D. programs and graduate education in the areas of military history and security studies. The use of distance and face to face educational programming as well as research conducted with military implications makes this collaboration most successful. Grow where planted.

Be opportunistic: If I were to neglect to mention the Biosecurity Research Institute at K-State and how it helped the University leverage a bid for the National Bio and Agro

Defense facility from USDA and the Department of Homeland Security, you would have been surprised. I use the phrase "be opportunistic" in the very best of ways. K-State invested strategically in the Biosecurity Research Center, Pat Roberts Hall, with its high level animal and plant disease research facilities. This facility was expensive to build and is expensive to maintain. It has, however, been central to the competition for the NBAF facility and the attraction of many new investments in the Manhattan area. The focus of research on infectious diseases continues to grow. The investment and opportunity have not been without complications. Currently animal facilities are being moved off the future NBAF site and site and infrastructure preparation for the new NBAF facility is underway. The moved animal facilities will be bigger and better equipped than the old ones. Investments had to be made to make this happen. Be opportunistic.

Hire well: As public universities struggle with funding, balancing tuition increases, state support and changing demographics, the hiring of new faculty to become the university of tomorrow is more and more critical. The faculty we recruit today will need to be competitive in the ever changing research arena. They will need to stay relevant in the classroom as well as in the laboratory, studio or library. We as administrators invest time, energy and resources in each new hire. We want to invest well for the future. As resources allow us to hire, we need to build on strengths and form synergies for success. After the hire we need to mentor for the continued success of each and every faculty member. Hire well.

I have discussed six strategies I think will serve us well in the research area today and into the future. The strategies: Diversity

funding sources, collaborate, build on strengths, grow where planted, be opportunistic and hire well are ways to maintain a competitive edge even in difficult times. Today's environment is one of competition for limited resources, declining state and federal funding and escalating infrastructure needs. The stakes are high. I compliment the organizers of this conference for the focus this year. We will

need to work together to share strategies and opportunities to control our own future in this changing world. The truly great resource we all have are people who are passionate about their work and the discovery of new knowledge in an educational setting. With that resource we are well prepared for any uncertain future.

Integration of Infrastructure and Process for Enhancement of the Research Mission of the University of Missouri

James English

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Among the unique strengths of any research university is a community of faculty members highly skilled and motivated in their scholarly pursuits. Any research community is highly diverse both in areas of scholarship and approaches to investigation. Many members of the research community also contribute significantly to the education and training of undergraduate and graduate students in classroom and laboratory settings. At the University of Missouri (or, as known locally, MU), the research and teaching missions include more than 1,900 faculty and instructors associated with 286 degree programs.

To the general public and perhaps many members of a university itself, the community of research and teaching faculty can appear as chaotic as a field of stars in a desert sky. Ideally, however, there is organization within this community that optimizes the success of the university research mission. The basis for success of the mission is effective integration of institutional resources including infrastructure (both physical and human) and support processes.

The perspectives of resource integration at MU that I present here come from two sources, the first being 20 years of my own research endeavors as a microbiologist and plant scientist. The second source is my association with faculty from many disciplines on the MU campus through five years of involvement with the university Research Council. For the last two years, I have overseen the functions of the

council (as Faculty Fellow for the Office of Research) that will be described later.

Integration of supportive resources is challenging within the complex research environment of MU or any similar university. Each faculty member has a unique professional history in terms of research training and experience. Additionally, each faculty member pursues research within a discipline-specific culture and with a propensity to work individually or as part of larger teams.

A basis for integration and management of institutional resources to accommodate disciplinary, cultural and personal diversity may be discovered by examining the day-to-day activities of research faculty. For example, on any particular day a faculty member invests time in management of research staff and training of undergraduate and graduate students. Additional time is given to assessment of research progress

for one or more projects, development of various manuscripts for publication or presentations for conferences, and preparation of new grant applications. Increasingly greater amounts of time are also given to grant administration activities such as budget management, reporting to funding agencies, and management of compliance issues.

Institutional support for these daily activities is provided at MU in a variety of ways at multiple administrative levels. At the most local level, support comes from faculty peers in a department or college. These peers often provide critical feedback on research questions and advise on grant administration issues. Input from peer faculty can be informal, in the format of hallway or coffee shop discussions, or obtained more formally through mentoring committees as assigned by a department chairperson.

Also at a local level, the department chairperson and administrative staff are central to sustained research progress of faculty. For example, the chairperson coordinates, if not provides, the start-up resources needed to launch new faculty hires towards early research success. In many departments, annual discussions between the chairperson and individual faculty members assist in development of a mutual understanding of research progress and insight into needs for additional or modified support resources. Finally, the department chairperson is responsible for the development and management of administrative staff in providing effective service in the support of research activities.

At a more regional level, the administrative staffs of individual colleges remain central to faculty research success. An efficiently coordinated business office, in particular, is useful for simplifying many of the daily tasks performed by faculty in managing their research programs. Beyond administrative support, some colleges at MU historically provided limited funding on a competitive basis to support new and innovative research activities. Although these resources have become increasingly scarce within many colleges, funds are still provided through program centers within specific research disciplines.

Although physically far removed from most research laboratories and offices, the MU Office of Research plays a very central role in the daily lives of faculty. This office is responsible for creating, maintaining, and nurturing an array of resources in service to the university research mission. Among the Office's responsibilities is grant management through sponsored programs administration, oversight and support of research cores and centers, grant writing support, management of technologies and intellectual property, assistance in research compliance, management of undergraduate research training opportunities and finally, support of internal grant opportunities for faculty via Research Council.

Although all aspects of the Office of Research operations are important, I will focus here on the contributions of the MU Research Council and Research Cores and Centers in supporting faculty research. The Research Council manages

funds that are allocated to support faculty through four competitive programs that include traditional research grants, international travel, research leave, and summer research fellowships. Research grants are funded at a maximum level of \$7,500 for a period of one year. These funds, though modest, have proven critical to faculty who are developing preliminary data for external grant submission, faculty who require bridge funding for research personnel, or who are completing data collection for final publication efforts. Travel grants of \$1,500 are provided to faculty members who make major presentations at international conferences or who are involved in conference organizing activities. Travel support is critical not only to international visibility of the faculty member but also to the visibility of MU. Research leave provides teaching replacement costs for faculty for a period of one year. The funds are particularly important for freeing faculty from heavy teaching loads to allow collection of data for ongoing projects, to finalize publishing of a major book project, or for exploring new research directions through interactions with colleagues at MU or at other institutions. Summer research fellowships provide two months of salary support for faculty to pursue research activities in a way similar to research leave support.

The Research Council annually reviews well over 200 proposals and allocates more than \$600,000 through these four programs. Last year, more than 190 faculty members received support for research-related activities. In my role as Faculty Fellow, I am

responsible for oversight of the Council and its deliberations. Proposals are received from faculty in all schools, colleges and professional programs on campus. Proposals are reviewed in much the same way as they would be reviewed at NIH, NSF and other federal science agencies. The diversity of applicants requires a similarly diverse council membership. Consequently, the Council has grown over the years to include 28 faculty members representing the array of campus research disciplines.

For multiple reasons the importance of Research Council to the MU academic community will likely increase over time. First and foremost is the increasing competitiveness of external grant programs. In addition, changing priorities of some federal programs has led to reduced external funding opportunities for specific scientific disciplines.

The research cores and centers supported by the Office of Research play increasingly important roles in the success the campus research mission. The cores and centers serve the research community by providing expensive equipment and expert technical personnel that would be difficult to develop by individual research faculty or by individual departments. The nine cores supported by the Office of research include the Cell and Immunology Core, DNA Core, Electron Microscopy Core, Molecular Cytology Core, Nuclear Magnetic Resonance Core, Proteomics Core, Informatics Research Core, Structural Biology Core, and Transgenic Animal Core. These research cores provide equipment and services not only to MU faculty but to faculty from

other academic institutions and commercial enterprises.

The cores are complemented by additional equipment and personnel resources at research centers across the MU campus. Among these are the MU Research Reactor, the Dalton Cardiovascular Research Center, the Christopher S. Bond Life Sciences Center, the International Institute of Nano and Molecular Medicine, the UM Bioinformatics Consortium, the Health Activity Center, the Interdisciplinary Center on Aging, and the Center for Arts and Sciences. University cores and centers will increase in their importance over time as scientific inquiry into the complexity of the world and universe becomes more sophisticated and more technically demanding.

At each of these hierarchical levels of research support at MU, there is a need to constantly assess the quality of resources directed to sustaining and enhancing the research mission and of any needs for enhancement. The means by which these assessments are made vary by specific administrative level and across institutional boundaries. In the Office of Research, annual evaluations of the office's Master Plan for Research and Technology Development are made to ensure that the immediate and future needs of the research community are being met. The degree of awareness by research faculty of efforts to integrate resources to support individual research programs is likely variable and may or may not be inconsequential to success of the research mission.

Building Infrastructure to Enhance Integration of Research and Education

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One way to sustain and enhance the research mission of a public university is to link it to other components of the overall mission of that institution. For example, public universities in general are expected to serve an instructional role, particularly at the undergraduate level. Those institutions designated as land grants have an additional component to their charge that includes education in the practical fields, as well as extension and outreach to the people of their state. If research and scholarly activity can be coupled to the instructional or land grant aspects of the institution, it helps to illustrate the value of research to all components of the overall mission. Federal funding agencies such as the National Science Foundation (NSF) have long made this type of linkage overt, in their focus on the broader impacts of any funded research project as an important criterion for merit review.¹

Buzz Words in Research and Funding

A perusal of grant solicitations reveals some words and phrases currently in vogue that suggest the directions in which funding agencies think that the research enterprise should be heading. Among these are:

- Collaboration
- Innovation
- Integration
- Interdisciplinary/multi-disciplinary
- Assessment/evaluation

The current extramural funding situation for standard single-investigator projects and larger overarching efforts is complex. The recent Federal stimulus

program delivered through the American Recovery and Reinvestment Act provided a strong “bump” in funding levels, especially from NIH and NSF, but there is concern that there will now be a corresponding dip next year. This is particularly true for NIH-funded challenge grants, all of which expire after two years.² It also is not clear to what extent the stimulus increased innovation in science; as the short- and long-term impact on innovation of Federal science investment in general is difficult to assess.³

Data suggest that interdisciplinary research approaches bring with them both challenges and benefits.⁴ As a National Academies panel begins to

examine how to make research universities more effective,⁵ an editorial in *Science* urges fostering the careers of young scientists through more collaboration, cross-disciplinary efforts, and integration of research and education.⁶

Challenges to developing truly inter- or multi-disciplinary collaborative research efforts at Kansas State University (K-State) include its traditionally decentralized culture, which vests extensive power in departments, as well as regulations of the Kansas Board of Regents regarding student enrollment minima for graduate programs. These were among the barriers to collaborative and interdisciplinary research initiatives identified by a recent K-State Presidential Research Infrastructure Task Force.⁷

Nonetheless, some progress has been made in recent years at K-State toward the national trends promoting collaboration and interdisciplinary work. These include an internally funded research support program as well as other programmatic efforts to link isolated education and outreach efforts and provide central resources to facilitate linking research and education.

Targeted Excellence and Other Collaborative Activities

The K-State Targeted Excellence (TE) program solicited proposals during five evaluation cycles from 2003-04 through 2007-08. This program was funded from tuition monies and managed jointly by the K-State Provost's Office and Vice President for Research Office. It was intended to "enhance those programs (primarily inter-

disciplinary) with the most promise of elevating the university's stature."⁸

The program considered cross-departmental projects that involved multi-disciplinary themes or ideas, projects that varied in duration from a minimum of one to a maximum of five years, and requests from \$50,000 to \$2,000,000. A total of 29 distinct projects was funded over the lifetime of the program; some represented relatively small investments to initiate projects (ca. \$100,000), while others were large collaborative awards of \$2M over multiple years. These major awards established new research centers and institutes, made seed funding available to stimulate innovative and collaborative research, and provided an important university resource for encouragement, support, and mentoring of junior faculty members. Some of these centers are described below.

- The *Ecological Genomics Institute* brought together scientists using cellular and molecular biological approaches with those interested in ecological and evolutionary questions to create new cutting edge research and synergize interactions across colleges and departments. Part of their funding was used as start-up for hiring two new faculty members and supported initial research projects by other individuals and teams.
- The *Center for Genomic Studies on Arthropods Affecting Human, Animal, and Plant Health* built on expertise of faculty members in Agriculture, Arts & Sciences, and Veterinary Medicine who work on a variety of areas including insect developmental genetics, biochemistry, animal disease, and plant disease. It built capacity in

genomics and bioinformatics through personnel hires and equipment purchases. New faculty members were supported through a seed grant mechanism and the establishment of collaborative work groups.

- The *Consortium for Global Research on Water-based Economies* (GRoWE) is a collaborative organization dedicated to helping people understand and manage the relationships between water resources and human consumption for agricultural production and livelihood. GRoWE organizes a multidisciplinary team of researchers who work together with stakeholders, agencies and policy makers of water resources to further scientific understanding of water resource systems for the purpose of making better management and policy decisions. GRoWE researchers are working on coupled model approaches (e.g. hydrologic-economic) and data standards and data models for linking models and modeling techniques (e.g. groundwater data model for ArcGIS).
- The *Center for the Understanding of Origins* is an interdisciplinary effort aimed at fostering interdisciplinary research addressing issues of origins, especially the origin of the physical universe, of the earth, of life, of intelligence, and of language. It comprises faculty members from the departments of Biology, English, Entomology, History, Geology, Philosophy, and Physics. They have developed undergraduate and graduate programs and sponsor both academic and public speakers, with the aim of transforming the discussion of important origins subjects such as evolution from one

of hostile arguments between "experts" and "special interests" to informed debate among citizens.

- The *Center for Sustainable Energy*, through research and educational efforts, seeks to provide sustainable, renewable energy while maintaining the environment and providing an adequate food supply. K-State offers significant educational and scientific resources related to the complete cycle of biofuels production. Basic and applied research, education, and outreach activities are components of the center. More than 30 faculty from across campus, including the colleges of agriculture, arts and sciences, and engineering, are involved in center activities.

Some of the projects established using TE funding have subsequently been developed into major extramurally funded projects. Many of these are interdisciplinary in nature and/or include aspects of or are entirely focused on broadening participation in STEM fields or integrating research and education. For example, the establishment of the Center for Sustainable Energy provided the foundation for a successful NSF Integrative Graduate Education and Research Traineeship (IGERT) project (Integrating the Social, Technological, and Agricultural Aspects of Renewable and Sustainable Biorefining (I-STAR)) as well as an NSF Research Experiences for Undergraduates (REU) project involving undergraduates in sustainability research. Faculty members from the Ecological Genomics Institute obtained an award from the U.S. Department of Education Graduate Assistance in Areas of National Need (GAANN) program to

create graduate traineeships in ecological genomics. They also won a renewal of an established NSF REU program with a new ecological genomics focus and have recently been awarded an NSF grant for Undergraduate Research and Mentoring (URM).

Two other TE projects, the Center for the Understanding of Origins and the Center for Sensors and Sensor Development led to two distinct NSF-supported Graduate Teaching Fellows in K-12 Education (GK-12) awards: “Evidence Based Inquiry into the Distant, Remote, or Past (EIDRoP)” and “Infusing System Design and Sensor Technology in Education (INSIGHT)”. Faculty members involved in the Consortium for Global Research on Water-based Economies recently received a major award from the NSF Geosciences Directorate for an interdisciplinary collaborative project entitled “Hyper-extractive economies and sustainability: scenarios for sustainable water use in the High Plains Aquifer” (0909515).

Other vehicles for promoting collaboration among faculty members and across units at K-State collaboration include a nationally recognized professional development school (*K-State Professional Development Schools*, 2009) that relies on collaboration among faculty in the College of Arts & Sciences, College of Education, and twenty school districts for the ongoing preparation of teachers. The Center for Science Education, housed in the College of Education, works with outreach efforts (GROW and EXCITE) as well as a variety of researchers in STEM fields, including the two GK-12 projects, a

recently funded Robert Noyce Scholarship Program, a nationally-funded 4-H curriculum on sustainability, and a recently funded EPSCoR project on climate change.

Other collaborative initiatives have emphasized linkages outside the university. The Consortium for Global Research on Water-based Economies (GRoWE) makes use of linkages with state agencies, extension and rural constituencies with regard to water usage. The recently established K-State Olathe campus acts as a test-bed for strategies that link research in animal health to education.⁹ Finally the Advanced Manufacturing Institute (AMI) has received a second NSF Partnerships for innovation Grant focused on building Kansas’ capacity to support technology related to the effective use of biofuels.

CORES

Targeted Excellence also funded a *Collaborative for Outreach, Recruitment, Retention, and Engagement in Science, Technology, Engineering, and Mathematics (CORES)*, which supports a variety of K-State outreach, recruitment and retention efforts in STEM disciplines. CORES links science/engineering-based K-12 outreach and undergraduate research/engagement programs, including those aimed at women and underrepresented minority students. Its goals are to synergistically enhance all of its constituent programs, facilitate recruiting and tracking of students, recruit students to K-State undergraduate and graduate programs, and to institutionalize and facilitate “broader impact” activities for K-State faculty preparing grant proposals.

CORES was developed by the interdisciplinary team that created the STEM middle school outreach program Girls Researching Our World (GROW). Members of this team were responsible for a pending proposal to the NSF Innovation through Institutional Integration (I³) solicitation. I³ is a cross-cutting program of the NSF Education and Human Resource (EHR) Directorate and is intended to link and enhance EHR-funded projects on a single campus. The K-State proposal builds on interdisciplinary research programs created as a result of TE and uses CORES as well as the K-State NSF ADVANCE program¹⁰ as models. A major partner is the K-State Office of Educational Innovation and Evaluation (OEIE).¹¹ The PI of the K-State I³ proposal is the Provost, April Mason. Co-PIs are Ruth Dyer, Senior Vice Provost, Jan Middendorf, Interim Director of OEIE, Beth Montelone, Associate Dean of Arts and Sciences and CORES Project Director, and Jacqueline Spears, Director of the Center for Science Education.

Pending K-State I³ Proposal: A Vision for Linking Collaborative Interdisciplinary Research and Education

The vision articulated in the proposal was of a robust institutional infrastructure capable of supporting integration of collaborative STEM projects for the purpose of broadening participation in STEM fields. The intent was to build on existing collaborative activities, especially those that involve integrating research and education.

Kezar¹² pointed out that there is limited research on how universities

move from a culture supportive of individual activity to one supportive of collaborative activity. Comparisons with a larger research base in corporate organizations suggest eight factors are important to university transformations: ". . . (1) mission; (2) integrating structures; (3) campus networks; (4) rewards; (5) a sense of priority from people in senior positions; (6) external pressure; (7) values; and (8) learning." (Kezar, 2006, p. 833). Rather than focus on moving the university as a whole toward a collaborative culture, we proposed using Kezar's research to inform efforts to integrate pockets of current STEM collaboration. The proposal focused on efforts to define a shared mission, create integrating structures, and broaden campus networks for the purpose of broadening participation in STEM fields, integrating research and education and fostering innovation.

The goals of the I³ proposal were to:

- Establish a faculty-led infrastructure designed to integrate existing collaborative STEM projects, encourage broader uses of collaborative strategies among STEM faculty, and identify institutional or departmental barriers to collaborative work;
- Build an internal evaluation capacity to support local program assessment, the identification of best practices, and central administration prioritization;
- Build an integrated approach to recruiting and retaining STEM undergraduates that is linked to university-wide

student recruitment and retention efforts;

- Increase faculty knowledge of and involvement in integrating research and education and the development of innovative programs.

Elements of the K-State I³ Project addressed the first three of Kezar's eight core elements. Promoting broader participation in STEM fields is a critical aspect of the university mission and offered a shared focal point around which university administrators, faculty and staff could engage. The faculty-led infrastructure proposed provided an integrating structure capable of encouraging broadened campus networks. In addition, we are in the process of using internal funding to develop an internal evaluation capacity to support the institutional learning important to continued integration and innovation. **Figure 1** provides a conceptual model that illustrates how funded projects and existing resources would be integrated as part of the I³ project.

The project goals would be accomplished through four proposed activities.

Activity 1

We proposed establishing a faculty-led office designed to: (1) integrate existing collaborative STEM projects for the purpose of broadening participation in STEM programs, (2) encourage broader uses of collaborative strategies and the introduction of innovative programs among STEM faculty, and (3) identify institutional or departmental barriers to collaborative work.

The I³ office would be headed by a STEM faculty member chosen from

among those involved in NSF-supported collaborative projects. The office would be advised by the K-State Associate Dean's Council and an Internal Advisory Board (IAB). Led by Associate Vice President for Research Guikema, the K-State Associate Deans' Council is comprised of the Associate Deans for Research of the nine K-State Colleges and meets on a monthly basis to discuss issues related to research and scholarship. This group is aware of the various STEM research projects being conducted across the university and could identify and share opportunities for collaborative STEM projects with faculty members. The IAB would be made up of faculty members who have a record of commitment to broadening participation in STEM programs and integrating research and education. Some of these faculty members are PIs of EHR projects, others lead allied efforts, and still others are directors of NSF research projects.

Activity 2

In order to link integration with innovation it is important to capture the synergistic relationships of the collaborative STEM programs. In addition, it is essential to capture the elements that make a program successful and replicable under given circumstances. As previously stated, the culture of collaboration at K-State is valued; however, it is neither widespread nor well integrated with larger institutional goals. It is imperative that we, as an institution rather than as isolated programs, understand what works under what circumstances. Therefore, we plan to build an internal evaluation capacity that will support

local program assessment, the identification of best practices, and central administration prioritization.

The Office of Educational Innovation and Evaluation (OEIE) has been in operation for over ten years and has been instrumental in providing evaluation services for several of the named projects and collaboratives, such as ADVANCE, Biofuels, CORES, Ecological Genomics, EIDRoP, INSIGHT, GRoWE, K-State-Olathe, and most recently the IGERT:I-STAR. Lessons learned during each of these projects have been beneficial in isolation, but it is clear that collective lessons learned have the potential to be much more valuable to the institution.

Under a shared goal of broadening participation in STEM programs, we proposed developing an evaluation infrastructure to promote increased assessment capacity, identify best practices specific to K-State, and develop a prioritization framework that will assist faculty members and administrators in determining the effectiveness of program investments. The goals of this activity are to: 1) adopt national best practices in assessment; 2) create a library of evaluation elements and tools that can be utilized by the I³ partner programs to easily and rapidly create instruments specific to K-State; 3) provide a global evaluation of university-wide programs' efforts designed to broaden participation in STEM programs; 4) utilize the global evaluation findings (meta-evaluation) to serve as baseline/benchmark for longitudinal studies; and 5) foster integration of research and education.

This effort is in process using internal funding.

Activity 3

CORES was designed with the decentralized character of the institution in mind and introduced a shared infrastructure that enabled each participating program to maintain its own structure and activities. A common website¹³ serves as a portal for 24 programs, providing students and families with a single, easily accessible entry point to all of the STEM outreach, recruitment and retention programs currently associated with CORES.

The CORES project also created a database of participants in its partner programs, which enabled individual program directors to: 1) identify and recruit students eligible for partner programs; 2) obtain data to support future grant proposals and to analyze data for use in research publications; and 3) allow tracking of students to determine the impact of these programs on K-State enrollment. Recently established partnerships with both the Office of Admissions/New Student Services and the Graduate School will enable these units to access the CORES database for recruiting new/transfer undergraduates and graduate students. In exchange, these two units are providing institutional support to maintain the database. Letters of support from the leaders of these programs document their commitment. The CORES database will provide the baseline data and tracking capability required for I³.

The programs participating in CORES serve a variety of purposes and target populations but share a common

focus on broadening participation in STEM programs by increasing the number of individuals from underrepresented groups. (As shown in Figure 1, with example programs listed in the K-14 and the Undergraduate and graduate research/retention boxes.) About half of the programs serve pre-college students or community college students and thus have a focus on recruiting future STEM students through outreach events. GROW, described above, is one example. The GK-12 projects and the K-State Robert Noyce Scholarship project will build additional linkages with K-12 schools. The newly developed K-State Olathe campus (K-SO) offers opportunities for direct links with the Olathe School District as well as other school districts in Johnson County, KS. In addition to a series of outreach efforts, One Health Kansas is supporting collaboration with three community colleges for the delivery of a public health course and building an educational pipeline for the masters in public health program. Other CORES programs, such as ELITE and K-State STEP, focus on the retention of STEM students at K-State.

Given that a shared infrastructure is in place and program directors have seen the value of collaboration, the CORES programs seemed an excellent cohort with which to explore increased integration. In conjunction with the CORES leadership, the I³ Office would be responsible for directing these integration activities. These activities include: (a) developing a comprehensive picture of the programs, populations served, and measures of success; (b) examining current data in an effort to

explore the extent to which participation in one program leads to participation in a second program as well eventual enrollment at K-State; (c) identifying outreach or retention gaps (e.g. groups not being well served by current programs); (d) developing a set of “best practices” gleaned from the internal evaluation effort (Activity 2) and discussions among project directors; and (e) working with faculty and graduate students to create innovative programs that are a direct result of the synergy established through these activities. *Rising Above the Gathering Storm*¹⁴ makes the case for the need for diversity. The importance of strengthening K-12 science instruction in order to increase the number of students open to STEM recruitment and retention¹⁵ as well as effective minority recruitment and retention practices¹⁶ also are well established in the literature. In a sense, these activities focus on creating a learning community among projects involved with recruitment or retention efforts for the purpose of developing a shared knowledge of the relevant research literature as well as locally specific best practices.

The net result of the suite of actions proposed as part of Activity 3 would be to build an infrastructure that allows programs to better integrate their efforts and be more effective at broadening participation. With regard to the programs involved in K-14 linkages, the goal is to develop a series of STEM educational and career pathways. With regard to institutional retention programs, the goal is to build the institutional capacity to foster STEM diversity. We intended to create a

culture in which broader impact activities are institutionalized.

Activity 4

In *They're Not Dumb, They're Different: Stalking the Second Tier*, Tobias¹⁷ explored why otherwise intellectually capable students avoid STEM fields. A recurring theme was the focus on problem solving skills to the exclusion of any larger intellectual overview or story line. Faculty members were the keepers of knowledge and students were expected to mimic the problem solving skills modeled for them in class. "Why" and "how" questions related to the various theories were never asked and the "second tier" students often wondered how various concepts were connected to one another. Tobias' second-tier students rarely learned about unanswered questions or cutting-edge research in their science classes. In presenting only what is known, introductory science courses lead many students to assume that there isn't anything left to discover.

REU and RET programs offer one strategy for engaging students and teachers in the process of discovery. In a recently completed EPSCoR project, Spears and Montelone explored strategies by which high school science teachers could integrate elements of K-State faculty research into their classrooms, strengthening students' understanding of the process of inquiry as well as demonstrating that there is more to be discovered in the sciences. Interdisciplinary research offers a particularly rich environment in which to explore linkages to outreach and recruitment/retention programs. Many of the "why" and "how" questions that Tobias' auditors hungered for are raised

through the process of combining different disciplinary approaches and exploring new connections. No single faculty member is the expert; all are deeply engaged in the process of inquiry. The very process of examining a phenomenon or problem from multiple perspectives invites innovation.

We proposed extending the CORES linkages with K-14 outreach and undergraduate and graduate research/education to interdisciplinary research projects. In conjunction with the CORES leadership, the I³ Office would be responsible for directing this activity. This included convening a working group of current participants in interdisciplinary research who will be responsible for: (a) developing illustrative case studies of how interdisciplinary research has been integrated into outreach, recruitment, and retention efforts; (b) designing and delivering faculty workshops on strategies for addressing "broader impacts" in research projects, both disciplinary specific and interdisciplinary; (c) providing seed funding and technical assistance to support innovative projects; and (d) identifying a set of strategies and "best practices" gleaned from the internal evaluation effort (Activity 2) and discussions among project directors. Included in the proposal budget were funds to support partial salaries for faculty members, postdoctoral fellows and graduate students in years two through five of the project to participate in the development of innovative programs based on their research.

Anticipated Outcomes of I³

An ultimate goal of I³ is to broaden participation in STEM programs. However, a secondary goal is building institutional capacity to support the integration of research and education. The first two activities would allow us to build an infrastructure consisting of a faculty-led convening authority and an internally maintained evaluation component designed to inform both the development of effective programs and the integration of those programs in support of university-wide goals. The third activity would allow us to test this infrastructure on a set of programs with a prior history of limited collaboration. The fourth activity would be the most challenging, in that only a couple of projects have tried to link interdisciplinary research with outreach, recruitment, and retention programs.

Example of a Current Collaborative Project: One Health Kansas

One Health Kansas¹⁸ (Program Directors L. C. Freeman and B. A. Montelone) was funded by the Kansas Health Foundation to:

- Promote awareness of interconnections among human, animal and environmental health
- Build the pipeline of public health professionals
- Provide broader and more in-depth education to current and future professionals
- Develop a public health workforce capable of addressing emerging and re-emerging zoonotic diseases

The organizational chart for One Health Kansas, shown in **Figure 2**, builds on relationships with faculty researchers, a graduate program (MPH),

the K-State Olathe campus, community colleges, K-12 school districts, CORES, Center for Science Education, and other universities. A series of collaborations is the key to managing this complex integrative project.

Example of Linkage of Research and Education: BRI

K-State's Biosecurity Research Institute (BRI)¹⁹ is a \$54M research and education facility with Biosafety Level 3 (BSL-3) and BSL-3Ag research capabilities. It features 14 research laboratories, small and large animal holding, plant growth chambers, an insectary, and a unique space dedicated to food safety research on an industrial food processing scale. The BRI includes an education and training wing with a classroom and mock training laboratory in which scientists, students, and staff can undergo training in general BSL-3 and BSL-3Ag practices as well as building-specific practices. Mobile camera systems in the containment and maintenance areas provide the opportunity for BRI to offer unique training opportunities for continuing education of scientists, veterinary practitioners, as well as mechanical and technical personnel. A recently funded DHS Center of Excellence in Emerging and Zoonotic Animal Diseases will support collaborative and interdisciplinary research and education using the BRI.²⁰

Summary

Although there are localized areas of collaborative work at K-State, the culture of collaboration is neither widespread nor well integrated with larger institutional goals. Under a shared vision of broadening participation in STEM disciplines and

integrating research and education, we proposed developing an institutional infrastructure to increase the synergy among existing programs, support assessment efforts that identify practices best suited to the economic and social climate within which K-

State operates, broaden STEM faculty involvement in collaborative activity and innovative programming, and guide programmatic/policy decisions at departmental, college, and university-wide levels.

References

1. Merit Review Broader Impacts Criterion, July 2007 (NSF, 2007). Accessed at <http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf>
2. Mervis, J. Science and the stimulus. *Science* 326: 1176-1177, 2009.
3. Lane, J. Assessing the impact of science funding. *Science* 324: 1273-1275, 2009.
4. Mervis, J. Panel explores what it'll take to keep universities strong. *Science* 329: 126-127, 2010.
5. Rhoten, D., and A. Parker. Risks and rewards of an interdisciplinary research path. *Science* 306: 2046, 2004.
6. Gentile, J., and S. Boehlert. Nurturing young scientists. *Science* 329: 884, 2010.
7. Sorenson, C., et al. *Report of the Research Infrastructure Task Force*, Kansas State University, June 15, 2010. Accessed at http://www.k-state.edu/president/initiatives/ritf/RITF_final_report.pdf
8. Cochran, A., M. D. Nellis, and R. A. Dyer. Targeted Excellence: Accountable Investment in Strategic, Interdisciplinary Collaboration. 2008. Accessed at <http://www.k-state.edu/provost/academic/presentations/hlcapril2008.pdf>
9. K-State Olathe Innovation Campus, 2010. Accessed at <http://olathe.k-state.edu/>
10. K-State ADVANCE Institutional Transformation, 2010. Accessed at <http://www.advance.k-state.edu/>
11. Office of Educational Innovation and Evaluation, 2010. Accessed at <http://www.k-state.edu/oeie/>
12. Kezar, A. Redesigning for collaboration in learning initiatives: an examination of four highly collaborative campuses. *J. Higher Ed.* 77: 804-838, 2006.
13. K-State CORES Project, 2010. Accessed at <http://www.k-state.edu/core>
14. Committee on Prospering in the Global Economy of the 21st Century, *Rising Above the Gathering Storm*, Washington, DC, National Academy of Science, 2006.
15. Davis-Lowe E. 2006. *Fostering STEM Diversity*. http://opas.ous.edu/Committees/Resources/Staff_papers/Fostering_STEM_Diversity.pdf
16. American Speech-Language-Hearing-Association. *Minority Student Recruitment, Retention and Career Transition Practices: A Review of the Literature*. 2007. <http://www.asha.org/practice/multicultural/recruit/litreview.htm>
17. Tobias. S. 1990. *They're Not Dumb, They're Different: Stalking the Second Tier*. Tucson, AZ: Research Corporation.
18. One Health Kansas, 2010. Accessed at <http://www.onehealthkansas.k-state.edu>.
19. Biosecurity Research Institute, 2010. Accessed at <http://www.bri.k-state.edu>
20. Center of Excellence for Emerging and Zoonotic Animal Diseases, 2010. <http://sites.google.com/site/ceezad/home>

The Institute of Advancing Medical Innovation (IAMI): Stepping into the future of academic research and entrepreneurship

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Scott Weir

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Program Director of IAMI, University of Kansas Medical Center

The Institute for Advancing Medical Innovations (IAMI) was founded in January 2009 with an \$8.1 million funding from the Kauffman foundation and a matching contribution from the University of Kansas Endowment Association. The \$16.2 million funding for five years was targeted to: 1) advance novel, new medical innovations for the diagnosis, treatment, prevention and control of human and animal disease to clinical proof of concept, 2) create a culture of multi-disciplinary, multi-organizational collaboration, and 3) prepare graduate and postdoctoral student for careers in development and commercialization of medical innovations. A staff of experienced project managers and management with over 100 years of pharmaceutical industry experience, and an external advisory board of experienced entrepreneurs and an adjunct faculty to mentor graduate fellows supports IAMI. Annual investment of \$1.6 million is for proof-of concept (POC) projects initiated by KU faculty both at the Lawrence campus and the medical center in Kansas City. This investment is intended as a key differentiator for the National Cancer Institute (NCI) designation for the University of Kansas Cancer Center and the Clinical Translational Science Award currently under preparation.

Introduction

Academic research in science and technology has been one of the main drivers in economic development, prosperity and dramatic improvement in public health in the developed countries. This is particularly evident in the 20th century United States with the discovery of the transistors, microelectronics, microcomputers and the Internet in the

telecommunications arena. In health sciences, the development of polio vaccine, antibiotics, and the advent of molecular biology, DNA structure, human genome and innovations in medical devices have revolutionized public health. Much of this discovery and development effort has strong roots in the basic science and technology research actively supported by the

government and the universities. For example, the development of the Silicon Valley and the biotech industries in California, Massachusetts, Washington, North Carolina and other states, are located around strong academic communities that promote venture capital and start up companies that have flourished since the 1950s.

The Institute for Advancing Medical Innovations (IAMI) currently in place at the University of Kansas (KU) is a bold step in this direction to promote translational research by the faculty and students which will contribute strongly to the economic development in Kansas and the Kansas City region. We anticipate that this effort in partnership with the Kauffman Foundation, Kansas Biosciences Authority (KBA) and regional animal and bioscience industry will promote entrepreneurship and economic development.

As shown in Figure 1, IAMI supports Proof-of-Concept (POC) projects in drug discovery and delivery

along with innovative approaches to drug-device development that can lead to commercialization through start up companies based on research funded at KU. Partnerships will be entertained and encouraged with national and international universities, companies and philanthropic organizations to deliver life-saving products to patients. Revenues from these activities will be used to fund translational research at KU and in the Kansas City region. As part of this effort, IAMI will provide training and mentoring for faculty and students on entrepreneurship, business development, intellectual property management and venture funding in collaboration with the KU Business School and the University of Kansas Center for Technology Commercialization (KUCTC).

Proof-of-Concept Projects:

IAMI and the Kauffmann foundation, the largest non-profit organization that supports entrepreneurship, intended that the

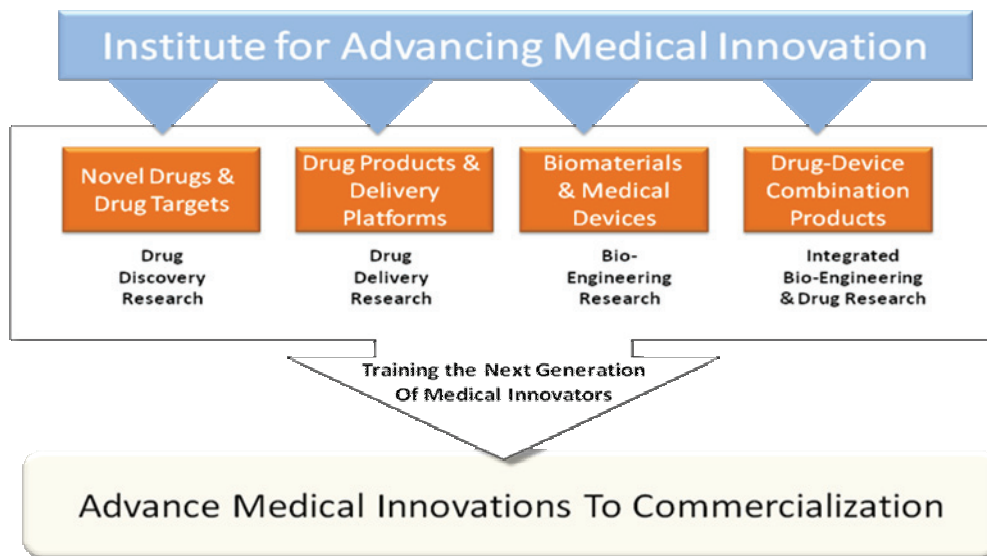


Figure 1: Functional architecture of IAMI

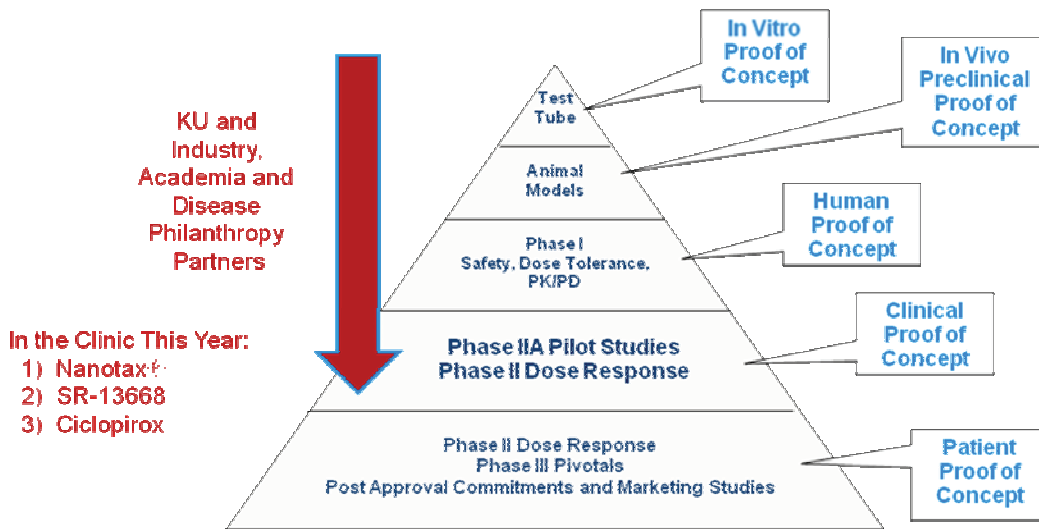


Figure 2: The Discovery and Development Pyramid

funds would leverage translational projects derived from federal research dollars to KU. The annual \$16 million funding will be for five years to support POC projects.

Figure 2 illustrates an idea that starts on pieces of paper and a test tube on the basis of basic science research supported by federal and philanthropic research grants. Scientists drive these ideas and projects through various stages of early development that mostly result in significant scientific publications and serve to train students and post-doctoral scientists. Many of the discoveries, when carefully evaluated, may have benefit for patients and the public and require rigorous research development activities before commercialization. Work needs to be done in in-vivo animal studies and then in expensive human clinical trials with appropriate product type (formulation, device etc.) to advance discoveries to the patients and the public.

In the past, this aspect of translational research is generally not funded by federal agencies or philanthropic research organizations, but carried out by multinational

corporations and biotechnology companies based on academic publications. Lack of such support resulted in lost economic opportunities for the universities, academic researchers and the region- generally identified as the “Valley of Death” for the projects that have commercial potential. The projects at this stage are too early for venture capital investment and too advanced for basic research funding. IAMI targets the translational research activities with specific milestone-based funding and project management support from industry experienced project managers and adjunct faculty.

Note that prior to the establishment of IAMI, the Office of Therapeutics and Drug Development (OTDD) lead by Dr. Scott Weir promoted three projects that are in the clinic as shown in Figure 2. Nanotax[®] is nano-crystalline form of Paclitaxel for ovarian cancer that is currently in Phase I at the University of Kansas Cancer Center, and was a KU innovation to minimize side effects in the current marketed formulation. The Ciclopirox Olamine is a project to support a blood cancer therapy with the

National Leukemia Lymphoma Society and the University of Toronto, Princess Margaret hospital, while SR-13668 is a collaborative project with the Mayo Clinic for cancer prevention. We have several other projects with Children’s Mercy Hospital in Kansas City and the Institute of Pediatric Innovation in Boston, on translational projects bringing innovative drugs and formulations for pediatric patients.

The requirements for selecting POC projects are shown in Table 1. Once the request for proposals (RFP) are announced within KU, principal investigators and students submit a letter of intent (LOI) to IAMI and meet with project managers to plan the preparation of the grant proposals. Note that the criteria described in the Table below strongly encourage applicants to submit relevant information on their science, technology, intellectual property and commercialization potential. These proposals are, therefore, quite different from other basic science grant applications. Both the faculty and students learn many aspects of innovation and commercialization that are not part of normal university curriculum.

| |
|---|
| • Medical innovation novelty (unmet need) |
| • Potential market size |
| • Market definition |
| • Medical innovation maturity |
| • Utility of proof of concept funding |
| • Intellectual property position |
| • Principal investigator credibility |

Table 1: POC Criteria: Project objectives, go/no go decision points, and detailed project plans are required for funding consideration.

The full applications are reviewed by the IAMI advisory board that consists of nationally and internationally recognized leaders in translational pharmaceutical research, device development and venture investments in start up companies (Table 2). Since early 2009, twenty-five (25) POC projects have been funded at an investment commitment of \$3.2 M to KU investigators in two review cycles.

| |
|---|
| Christopher P. Austin , Director, National Institutes of Health Chemical Genomics Center |
| Steven D. Averbuch , Vice President, Oncology Global Clinical Research, Bristol-Myers Squibb Company |
| Michael D. Webb , Executive Chairman, Virtify, Inc. |
| Anand C. Burman , Chairman of the Board, Dabur India Limited, New Delhi, India |
| David Vranicar , President, Heartland Bioventures, Kansas Bioscience Authority |
| David Jenkins , Managing Partner, FatBoy Capital, L.P. |
| Thomas Wiggans , former Chief Executive Officer and Chairman of the Board, Peplin, Inc. |

Table 2: The IAMI advisory Board and their affiliations. All but Dr. Austin are KU alums with successful careers in biotechnology and medical device industries.

IAMI Fellows Training Program

As part of its commitment to the educational mission of the university and training entrepreneurs, IAMI funds fellowships for 10 graduate students and 4 post-doctoral scientists at KU on an yearly basis. One additional post-doctoral scientist is funded at the Kauffman National Fellowships program through IAMI. The Fellows come from business school, chemistry, biology, engineering and related programs at KU, and have projects that are innovative. They are required to attend regular group meetings, meet with assigned adjunct instructors as

mentors (Table 3), and submit annual progress reports to the IAMI management and the advisory board. They are required to work with KU Business School to develop business plans and funding proposals for venture capital firms. This is a unique opportunity for the IAMI fellows to develop their science and technology and conceptualize their business plans.

| |
|--|
| Mike Baltezor (Formerly Enturia Inc, a Cardinal Health company, Kansas City, KS.) |
| Andrew Parkinson (Xenotech, Kansas City, KS) |
| Tony Barnes (Rules Based Medic, Austin, TX) |
| John Neet (J.M. Neet & Associates. Lawrence, KS. |
| Mike Beckloff (Beckloff Associates, a Cardinal Health company, Kansas City KS.) |
| Matt McClorey (Lawrence Regional Technology, Lawrence, KS.) |
| Tom Engler (Eli Lilly & Co. Indianapolis, IN.) |
| Ken Lynn (New Link Genetics, IA) |
| Bo Fishback (Kauffman Foundation, Orbis Pharmaceuticals Inc., Kansas City KS.) |

Table 3: IAMI adjunct Instructors: experienced entrepreneurs from Kansas and around the country.

The Ellis Family Seminar Series:

Through a philanthropic contribution from a donor, the Ellis Family Symposium was inaugurated in 2010 at the KU Lawrence campus and the medical center campus in Kansas City. The seminars are open to the public and are intended to invite individuals from regional industry, universities, and research institutes to discuss innovation and commercialization concepts in their own experience. All fellows are required to attend the seminars and special engagements with the speakers are also scheduled before or after the

seminars. These interactions are designed to encourage free flow of ideas and discussion between IAMI fellows and reputed entrepreneurs and business owners who are successful in their own right.

Conclusions:

Academic research supported by federal agencies such as the National Institutes of Health, National Science Foundation and philanthropic organizations have narrowly focused on basic and applied science and technology that results in publications and serves the educational missions of our universities. However, even after the Bayh-Dole act of 1980, there is very little funding or infrastructure that supports translational research and promotes entrepreneurship, commercialization and job creation. Traditionally, the discoveries from academia have been exploited by multinational corporations and biotech industries concentrated in a small number of regional centers. More and more local and state governments are recognizing job creation potential and its impact on economic development in their localities - IAMI is an example of this desire to exploit academic innovations.

IAMI is an innovative idea to support faculty entrepreneurs and local and regional economy by leveraging industrial expertise to commercialize discoveries at KU. As shown in Figure 3, by encouraging partnerships between researchers at both campuses and providing project management expertise, process re-engineering and training, we are fostering a culture of collaboration and innovation. An ultimate challenge in creating such

models in the academic environment is its sustainability over the long term and

its impact on the local and national economies.

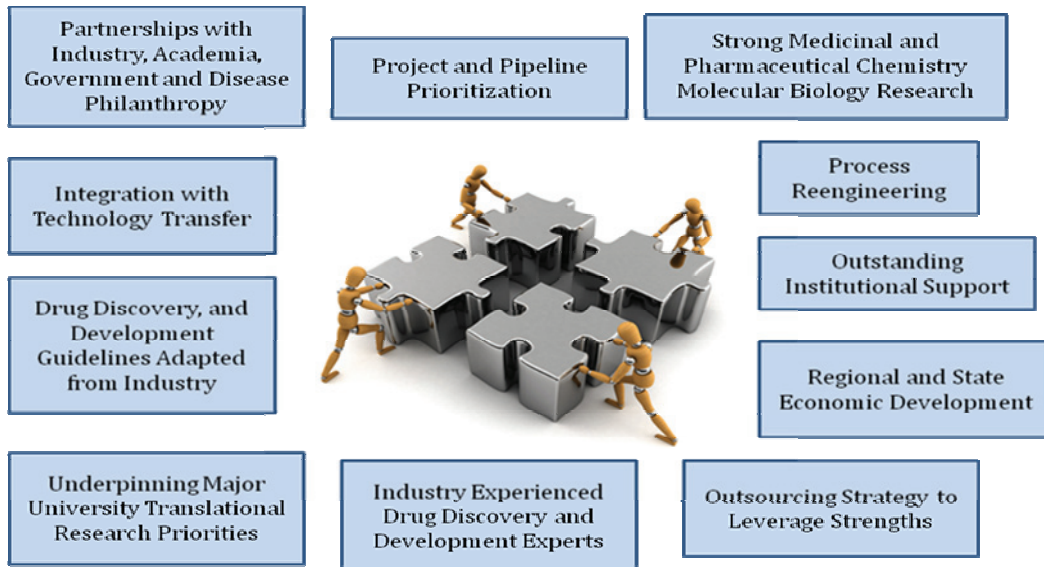


Figure 3: Transforming Federally Funded Research into medical innovations

Useful References:

P.L. 96-517, Patent and Trademark Act Amendments of 1980.

http://www.access.gpo.gov/nara/cfr/waisidx_02/37_cfr401_02.html.

Merrill SA, Mazza AM (Editors) "Managing University Intellectual Property in the Public

Interest". Committee on Science, Technology, and Law Policy and Global Affairs, National Research Council, National Academies Press. October 5, 2010.

Positioning the University in the World of Higher Education Research

Brian Foster

Provost, University of Missouri

Major research universities are about two main ends: impact and stature. Impact is really the end goal. It is about training the best professionals, researchers and others who change the world by conducting research that leads to new technologies, to a new basic understanding of the world, and to new practices in medicine, business or other areas; and it is about delivering highly effective health care, economic development, and other practical services. Impact is the end game, but stature is a necessary condition; it determines the institution's ability to attract the best faculty, students, and staff, and to get grants and contracts that enable research, services, and other means of achieving the greatest impact.

The idea of “positioning” a research university is critical to the objectives of impact and stature. At the University of Missouri (MU), we have focused on this matter in a very purposeful way, recognizing that for MU to achieve the level of impact to which it aspires, it has to compete effectively with the best universities in the world. To do so, we at Missouri need to compete with the biggest and best universities on our turf, not on their turf. We have to compete in the areas in which we have unique strengths—competitive assets—that allow us to do things that others, no matter how great their stature, cannot.

This article outlines the goals of the Mizzou Advantage—the University of Missouri's approach to positioning the institution in the world of higher education—and the ways MU is implementing this large and complex initiative.

I. Creating the Concept of the Mizzou Advantage

The Process

Nearly four years ago, MU began a process to identify the competitive assets (we called them “strategic advantages” then) that could be the foundation for several long-term initiatives that would position the university in the way outlined above. A task force of very prominent and respected faculty was formed by the provost to frame the process, to identify several potential strategic advantages, and to seed a broader discussion with faculty, deans, alumni, students, staff, and others.

With the Task Force's suggestions of possible strategic advantages in hand (about ten of them), the provost organized a broad set of faculty discussions to validate (or eliminate) items on the list, to better articulate them, and to add new ones. These

discussions took the form of “faculty forums” to which all MU faculty were invited. The idea was to have meetings of no more than fifty people, so that significant interaction and discussion could occur; as many meetings would be scheduled as needed to accommodate all interested faculty. Similar discussions for staff and students were held. Several hundred faculty and others participated in highly thoughtful and productive discussions that provided input to the next round of meetings of the Task Force.

When re-convened, the Task Force carefully considered the input received in the forums and made significant adjustments in the list of strategic advantages. Then, based on this final, refined list, the Task Force turned to identifying five “strategic initiatives” that would be firmly based on the strategic advantages. The five tentative initiatives were then discussed by many faculty and other constituents in venues similar to the earlier faculty forums. Again, several hundred people participated, and the discussions were even more productive, focusing not only on the definition of the initiatives, but also on implementation and expected outcomes.

Following these extremely useful discussions, the Task Force met again to finalize the list of strategic initiatives and to outline a strategy for implementation. Several important principles emerged from the discussions that have shaped the implementation efforts that have now been underway for more than a year. Among the most important was that the initiatives would be VERY interdisciplinary. This builds

on MU’s very strong interdisciplinary research culture.

There was broad agreement in the forums that we would not create new “silos” such as new centers or institutes, but rather each initiative would be associated with a network of MU faculty, centers, departments, staff, core facilities, and external collaborators including other universities, national labs, corporate partners, research institutes, consulting firms, foundations, and any other organizations or individuals with whom productive collaborations could be formed. Accordingly, the networks would not be guided by a “traditional” administrator (e.g., dean, director), but rather by a facilitator whose charge is to bring people and organizations together in productive collaborations.

There was also broad agreement that the network for each initiative would be very inclusive: the initiatives were framed specifically to allow this breadth of participation (see the descriptions of the initiative areas below). In fact, EACH of the five can readily include participants in humanities, physical sciences, engineering, biological sciences, professions (medicine, veterinary medicine, law), business, education, journalism, social sciences, agricultural disciplines, and others.

The Five Initiatives

One Health, One Medicine. One of MU’s most important assets is that our programs in Medicine, Veterinary Medicine, and Animal Science are contiguous, and there is significant collaboration in all directions, including joint appointments. Moreover, located between the three is the Bond Life Science Center, a large and very interdisciplinary research facility that brings together not only the three programs above,

but also faculty, staff, and students from Biochemistry, Biological Sciences, and other units. The One Health initiative is founded on the already strong collaboration of these three units, but it is much broader. For instance, Kansas City is the world's largest center of corporations in the animal health business; MU has many collaborations in this vital environment. Other health units are closely related, including Nursing, Health Professions (e.g., Health Psychology, PT, OT), and Biomedical Engineering. Many other centers also connect strongly to One Health: e.g., the Dalton Cardiovascular Center, the Thompson Center on Neurodevelopmental Disorders, and the University's Research Reactor [the most powerful research reactor on any campus in the US]. Other resources include a state of the art Brain Imaging Center. But beyond such specifically health-related disciplines, there is strong collaboration with areas such as the Trulaske College of Business, the College of Education, literary studies, Psychology, Anthropology, Policy Studies, and the MPH program.

Food for the Future. The University of Missouri is located in the middle of a large and diverse agribusiness area...in fact, agriculture is the largest industry in the state. And on either side of the state are strong agribusiness partners. St. Louis is home to some of the world's most prominent plant science centers, the Danforth Institute and the Monsanto Company. Kansas City, as noted above, is the world's largest location for the animal health industry. Taken together with MU's Plant Science group, one of the three strongest in the country, and the Veterinary Medicine and Animal Science programs, the University is positioned strongly in areas of research related to food and to training

world-class professionals in fields related to food. Although the anchors for the Food for the Future initiative are related to food production, the University's resources are far broader. Nutrition and chronic disease, for instance, are strong programs. As with all major industries, most of the key decisions are based on business considerations—an especially complicated and interesting matter given today's global food industry. The culture of food is of great interest to many in the humanities and social sciences (e.g., concerning the central place of food in rituals and ceremonial events throughout the world, the cultural drivers of eating behaviors, the symbolic importance of food in intercultural relations). Policy, environmental, educational, and media coverage of food are areas of interest to MU programs. In today's environment, food safety is a critical concern as is food security (i.e., access to sufficient food for people of lower socioeconomic status). Like One Health, Food for the Future is a topic of vital interest to virtually every academic college at MU.

Media of the Future. It is widely known that MU's School of Journalism is the oldest and arguably the best Journalism program in the world. Also well known is the fact that the media world—especially paper media—is in a state of transformational change, much of which is driven by new digital media, in which the MU School of Journalism has special strengths. The high stature of the School has been greatly enhanced by the founding of the Reynolds Journalism Institute, a world class think tank focused on the future of media. No other university can match the core, forward-looking media presence of MU, but as with the other initiatives, the media initiative stretches

far beyond the School of Journalism. For instance, it is well known that the impact of digital media on marketing is at least as great as on newspapers and magazines and, accordingly, interest in marketing, advertising, and related topics is great. The implications of changes in media for the American democracy are enormous. Of course, the engineering interest in creation of digital media technologies is great. Policy issues, public information, cultural communications, public education, and other functions depend heavily on media and are in a state of transformation. The processes of education in schools and universities have been dramatically affected by developments in media—an area of very robust research and educational attention at MU. The archival functions of libraries are in a dramatic state of change, as is the world of scholarly publishing—areas of great interest to MU researchers and to the MU Libraries. Again, as with the other initiatives, Media of the Future is of great interest to virtually every unit on campus and to a broad array of external collaborators including media outlets, press associations, other universities, and federal agencies.

Sustainable Energy. MU's location in the middle of an enormous agribusiness area has stimulated substantial interest in biofuels of all kinds, engaging faculty in units as diverse as plant science, agroforestry, and bioengineering. In addition, the presence of the research reactor has stimulated broad educational and research interest in nuclear energy. Of course, both of these areas stimulate

great interest in environmental issues and associated legal and policy implications. Environmental issues related to biofuels interact with food production, as does the allocation of agricultural resources which is based primarily on business decisions. The logistics of energy distribution are of great interest as well as energy storage for wind and solar. If storage can be achieved, wind and/or solar become quickly cost effective. The uses of energy are of great interest in many academic units, as in Architectural Studies, in Engineering (e.g., design of vehicles), and in steam production (e.g., the biomass facilities of the MU physical plant, which is a model of national interest and a center of education and research). Energy use of data centers is of interest to MU researchers. Advanced battery technologies, in collaboration with prominent Missouri corporate partners, is a significant research focus of several faculty. The global nature of the energy industry is of great interest in all of the above matters, since energy costs, distribution, production technologies, and other matters are among the main drivers of the global economy. Although the future of the energy industry and our uses of energy are anything but clear, it is entirely clear that our reliance on fossil fuels is not sustainable even for the intermediate future, and new energy technologies, with all of the policy, diplomatic, business, ethical, and cultural implications, will be key elements of our future.

Understanding and Managing Disruptive and Transformational Technologies. One important aspect of the

four initiatives discussed so far is that all concern areas that are undergoing fundamental change. Many MU faculty and collaborators have focused on understanding these changes. From one critical perspective, business as we have known it in the four areas is approaching chaos and is not sustainable even in the intermediate term; perhaps even more important, future directions are unclear. The same could be said for policy, ethical, cultural, social, and psychological aspects of all four areas: all are changing in fundamental and unpredictable ways. The one thing that is clear is that changing technologies are at the root of many of the changes, though on the surface, these technological developments are playing out in very different ways. In all cases, the dynamics are global, with key inputs from international economic, political, and diplomatic processes. Thus, understanding and managing these dramatic technological changes requires broad academic input from all of the areas mentioned above. In many disciplines there is established research on the management of technological change (e.g., the business literature on disruptive technologies). But environmental, cultural, and political aspects of these changes are of great interest as well. A key element of the technology initiative is to bring together the diverse perspectives on campus to come to a more general understanding and, thereby, a greater ability to manage the volatile conditions in which we find ourselves.

II. Implementation: What are we Actually Going to Do?

We have begun an aggressive, multi-year roll-out of the Mizzou Advantage (the five initiatives collectively). It is important to stress at the outset that MU already has

considerable strength in these five areas. Given the breadth of the areas and the dynamic composition of the collaborative networks, it is difficult to estimate the magnitude of the university's activities, but our "back of the envelope" estimate is that we spend approximately \$200 million total each year, including faculty and staff salaries, graduate assistant compensation, grants, gifts, general operations, facilities costs, fee-for-service contracts, and more. Our goal is to strengthen these broad areas in ways that enhance MU's impact and stature, as outlined above.

Very broadly, we have identified several million dollars that will be directed toward the enhancement of the initiative areas in ways outlined below, and we have created a support structure to help carry out the operations. It is important to stress that the discussion below focuses on the research dimension of Mizzou Advantage, but that there are integral and equally important components for instruction, economic development, and public service.

Mizzou Advantage Activities

Implementation of the Mizzou Advantage began with a series of lunches and late afternoon meetings with hors d'oeuvres to explore possible network connections among individuals, mostly MU faculty, but also a significant number of external people (e.g., CEO of a biological sciences company, head of the Missouri Press Association, and senior faculty from another nearby university). Each of the events was by invitation, the list of invitees coming from discussions of the provost with deans, center directors, and key senior faculty in the initiative areas. These events were extremely lively and

productive, in many cases bringing together potential collaborators who literally had never met or even heard of each other.

Very shortly after implementation began, the provost issued an RFP for seed grants and networking grants. The latter awarded up to \$20,000 for symposia, workshops, conferences, or any other kinds of activity that would help build the networks in the five initiative areas. Seed grants of up to \$50,000 were awarded to long-term, large scale projects that would move the Mizzou Advantage agenda forward. As with the networking grants, a key objective of the seed grants was to bring collaborators together, though in this case working on formation of a specific project. A total of about \$950,000 was awarded in this first round of grants; a second round will award up to \$1.5 million late in the fall. A third round, funded from the Chancellor's Fund for Excellence, will be targeted for seed projects with major external collaborators.

The idea of forming strong networks is central to Mizzou Advantage. As suggested above, much of the network creation consists of making relationships between people, academic units at MU, and external partners such as corporations, other universities, national labs, think tanks, and consulting groups. One important way of forming such relationships is by having events on campus that bring potential partners together for relevant interaction. Targeted conferences, workshops, symposia, and other events are an important part of Mizzou Advantage, and one important support

function is provision of professional event coordination and planning assistance (see below). It is important to note that the relationships formed in conferences and the events themselves not only support the research networks, but they greatly enhance the vitality of the campus intellectual life.

The creation of networks is not, however, simply a matter of creating relationships among pairs of potential collaborators. The structure of the network is also of great importance—the robustness, size, and focus are critical network elements. For example, it would be unwise to invest heavily in infrastructure to support a network which centered around one key person, loss of whom would destroy the collaborative group's functionality. Nor would a research network be viable if a key "connector" was an ineffective researcher. A diverse set of people at MU are using state-of-the-art network analysis techniques to model our collaborative networks and the potential relationships that could be brought into the networks (e.g., co-investigators on grants, co-authors, co-members of doctoral committees, and faculty who teach classes jointly). (See appendix for a brief sketch of how such structural elements will be considered in Mizzou Advantage.)

Bringing potential collaborators together at a conference, workshop, or just a networking reception is valuable, but productive collaboration will depend in many cases on each getting a better sense of the other's discipline. To assist with this kind of professional development, Mizzou Advantage has budgeted \$200,000 for "faculty

development” awards each year for a faculty member to attend a meeting in another discipline or otherwise develop needed expertise. These awards, up to \$2,000, will go to those who are actively developing relationships and projects in the Mizzou Advantage areas; award of these funds will begin in the fall, 2010.

A central part of building strong collaborative networks will be strategic hiring. Funds have been budgeted to provide \$50,000 in recurring support to incentivize each of twenty-five strategic faculty hires in the colleges and to increase attractiveness of compensation packages by complementing the units’ funds. These faculty hires will be targeted to enhance the strength of the networks; many will be interdisciplinary. The colleges/ departments will provide the underlying salary and the largest part of start-up costs, though a significant budget is available to assist with start-up costs as well. Criteria for such hires will include (a) providing a link between two or more clusters of collaborators with potential to position the university prominently if they could come together, (b) providing a critical kind of expertise to move forward a longer-term effort for which other resources are in place, and/or (c) providing a link between a very strong group on campus, a potential collaborator such as a national lab, and an agency with interest in funding a mega project in the area. This kind of hiring will begin only after we have achieved a better understanding of the current underlying networks on campus and will be done over a period of approximately five years. The first search processes will occur within the next year or so. Finally, the Chancellor’s Fund for Excellence will

sponsor several endowed professorships in the Mizzou Advantage areas.

Similarly, there is budget for a \$250,000 match to hire each of four very distinguished faculty—e.g., Pulitzer Prize winners or members of the NAS. As with the other twenty-five hires, the Mizzou Advantage match will help units make very attractive offers—e.g., assume a joint appointment with underlying salary of \$150,000 from each unit plus the \$250,000 match, totaling a \$550,000 compensation package. Again, the point of the hires is to strengthen network structures, to bring strong clusters together, and/or make relations with external funding agencies or collaborators. These hires will be made over a period of several years—perhaps one every two or three years—to spread out start-up and other costs that in the short term are likely to be much more costly than salary.

Infrastructure

A key step in implementation was the appointment of an Advisory Board to assist with all aspects of the definition and operation of the Mizzou Advantage. This board was appointed by the provost and consists of distinguished faculty from a broad range of academic disciplines (arts, humanities, biological sciences, physical sciences, professions, business, education), and of key support staff (e.g., library, IT, Research Office, and Extension). One of its first tasks was to assist in appointing the facilitators and an education coordinator—the key leaders of support functions for the five individual initiatives and the education programs. This board also did the review functions and recommended funding for an initial round of

networking and seed grant proposals received in response to the above-mentioned RFP which was issued about the time the facilitators were appointed.

As noted above, the infrastructure for the five initiatives is unusual insofar as it is not based on centers, institutes, colleges, or other “normal” organizational units. Nor is there a standard line structure of administrators such as directors, chairs, or deans. This point is important, because a key objective of the implementation is to avoid creating new silos, but rather, to make the walls of existing silos very penetrable. It is also important to stress that MU is committed to sustaining, supporting, and strengthening the academic disciplines that are generally associated with colleges and departments, because our aspirations for the five initiatives of the Mizzou Advantage are based on the synergies that come from the interactions of different disciplines. The goal is NOT to eliminate or compromise the disciplines, but to bring them together in productive, synergistic ways.

The core of the infrastructure is a “facilitator” for each of the five initiatives plus an “education coordinator” who is working with the five facilitators to create educational certificate programs. The facilitators are all senior faculty with expertise relevant to the content of the initiative activities. Their main job is to form the collaborative networks described above – not only linking faculty across department and college boundaries, but also linking individuals and campus units with diverse external entities. The facilitator positions are part-time, a

signal to the MU faculty that the facilitators remain first and foremost researchers and teachers, and that the academic life of a facilitator continues to be very similar to that of a faculty member. The facilitators are housed together in a single office suite with the education coordinator; they all meet together regularly, but most of their time is spent in making contacts with potential collaborators, exploring possible projects, and generally creating the collaborative networks that are the core of the Mizzou Advantage. It should be noted, though, that their frequent interaction helps identify and support the overlap of the five areas.

As noted above, it is important that the facilitators are focused not just on making relations among collaborators, but also on constructing robust network structures that are not vulnerable to loss of a single key individual or two—networks with multiple relations tying clusters of collaborators (people and other kinds of collaborators) together. An important property of the networks is that they are dynamic in membership and structure, since specific collaborators will be more actively engaged at some times than others—some even uniquely for a specific project—as different funding and other opportunities present themselves. One important element of the facilitators’ activities is working with deans and departments in hiring strategically placed individuals to strengthen the network clusters. Each facilitator has a significant amount of discretionary funding—approaching \$100,000 per year—to seed events and otherwise

support their network-building activities.

The work of the facilitators and other staff is supported by the Mizzou Advantage coordinator and administrative assistant, who provide a broad range of services, e.g., scheduling meetings, assisting with correspondence, coordinating facilitator relationships with the chancellor's and provost's staff members, with faculty and other academic administrators, and managing relations among themselves and other support staff for Mizzou Advantage.

Other critical support comes in three important functional areas. First, given the central importance of networking—of relationship building—it is critical that there be effective (and cost effective) support for event coordination. This involves all that it takes to arrange a good event, including web-site design, registration process, blocking hotel space, catering, booking meeting space, arranging needed IT, and so on. Mizzou Advantage has funded new staff for the MU conference office to provide such support. This means that faculty, staff, and others who are arranging conferences, workshops, symposia, and other events related to Mizzou Advantage will have professional support for arranging the logistics of these events and will have virtually none of the faculty and staff time diverted to event arrangements except the networking activity.

Second, it is critical that the faculty have professional support for writing grant proposals. MU has created a national model for a “grant writer network” which has approximately fifteen grant writers distributed across

campus, each working in a discipline or discipline cluster environment and thus aware of the specific “customs” and “rules” and “practices” of agencies funding relevant research. Mizzou Advantage has hired a senior grant writer to work with the faculty networks and the grant writer network to provide maximally effective support in proposal preparation.

Third, we believe that the Mizzou Advantage will open opportunities for fund raising that are new for MU. The five initiative areas are such that they may provide opportunities for major gifts from donors with passion in these areas—donors who want to “change the world” in an area for which they have a strong passion. The Mizzou Advantage fund raiser will be building relations with such potential donors based on the idea that MU has world-class programs in these areas that can make a big impact—can, so to speak, “change the world.” From a slightly different perspective, if a person is wealthy and would like to leave a mark in a particular area, he or she would be looking for the university (or collaborative network) best suited to “make a mark,” and we will argue that the five initiative areas fit such a profile.

A final support function that began two years ago has now been folded into the Mizzou Advantage. It concerns a broad-based effort to cultivate relationships with the most distinguished scholars, practitioners, writers, artists, and others—members of the National Academies, Pulitzer Prize winners, Nobel Laureates, and others of the greatest stature and impact. This effort aims, on the one hand, to increase

the vitality of campus intellectual life by having MU faculty, staff, students, and collaborators interact with the most powerful intellects. Inviting such distinguished visitors to be keynote speakers at Mizzou Advantage conferences and other events, for instance, serves this purpose. On the other hand, such people are “at the table,” so to speak, for conversations that shape the federal and state agendas, that drive research future of different academic disciplines, and that form the long-term research interests of the corporate world. Relationships with such people help MU get in the conversations about shaping the future of research, forming large contract projects by federal agencies, establishing relationships with National Labs, and joining large collaborations in key research and business projects.

Conclusion

Clearly the Mizzou Advantage is a work in progress in several ways. We have a broad concept that was carefully developed, with the participation of hundreds of people. We received much thoughtful commentary about implementation and operation of the project, but in the end, the process produced a concept, not a well defined structure—as it should be. So, one dimension of the “work in progress” is definition of the structure—of precisely what it is that we are trying to achieve and, very generally, how we will do it. The concept will continue to adapt as the research environment changes, as our positioning develops, and as content areas continue to evolve, but broadly speaking, the “concept” will have continuity over a fairly long time. A

broadly inclusive discussion of these basic issues will continue in a purposeful and structured way.

A second dimension is the operational detail of how we will implement the Mizzou Advantage. This goes far beyond the “concept” to the identification of individuals and organizations in the networks, to creation of the support infrastructure, to identifying funds, to proposing and getting funding, building infrastructure, and actually carrying out successful, impactful projects. The changes in the operational details of Mizzou Advantage will be continuous as new projects are initiated, new collaborators are engaged, new networks are formed, and most importantly, as new ideas are created. These changes will be guided by the continuity of the Mizzou Advantage concept or, perhaps better, changing constantly to achieve the Mizzou Advantage vision...and provide a strategic focus and a foundation for moving forward as the current fiscal challenges recede.

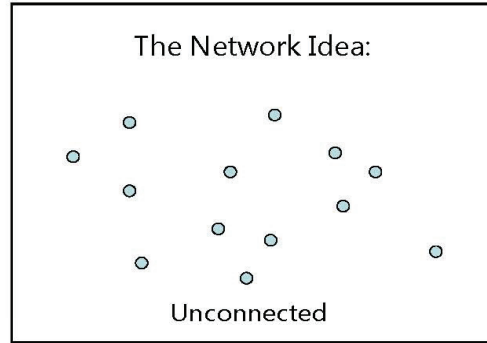
A third dimension of the work in progress is telling the story. Although the core ideas are constant, the form of the story varies with different constituent groups. And the story for research is different from the one for education, for economic development, or for delivery of services. The story will also take different directions as the various projects play out, as new people and organizations join the networks, as major contracts and grants are received, and, most importantly, as results of the Mizzou Advantage activities impact research, economic development, students’ careers, quality of health care,

food security—as the activities of goal of impact, of making the world a
 Mizzou Advantage begin to achieve our better place.

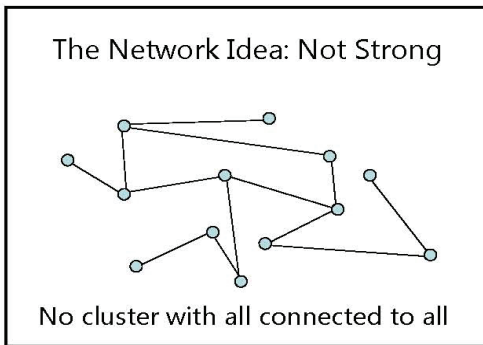
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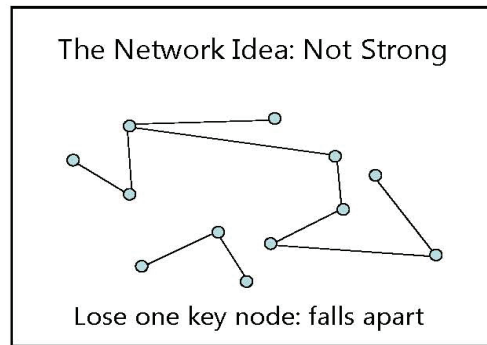
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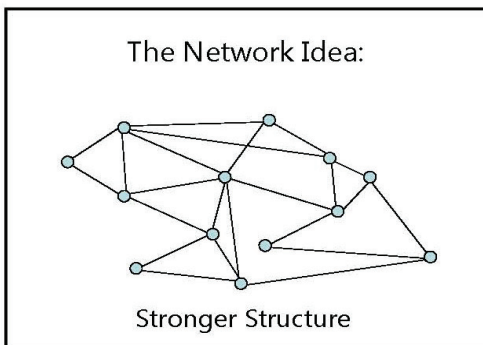
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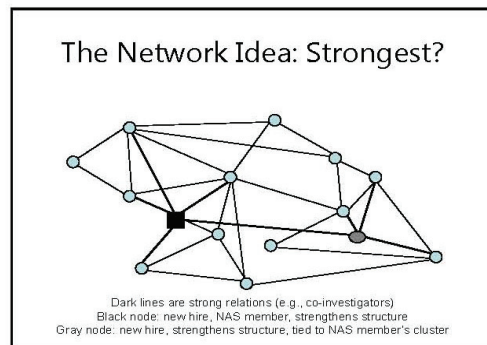
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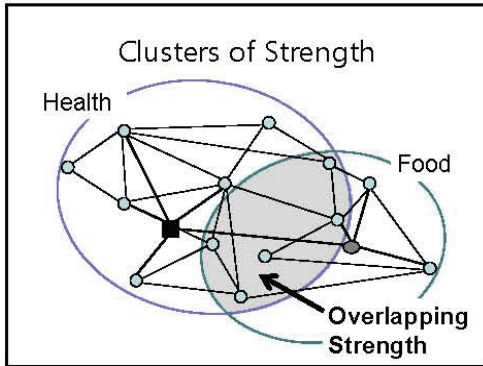


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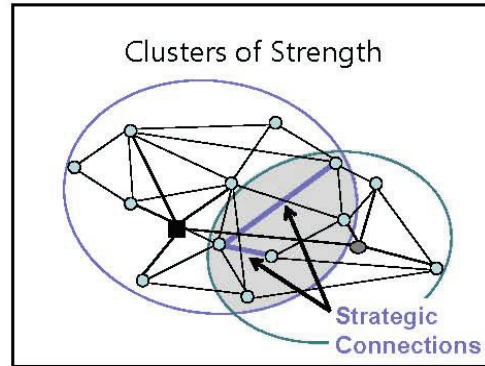


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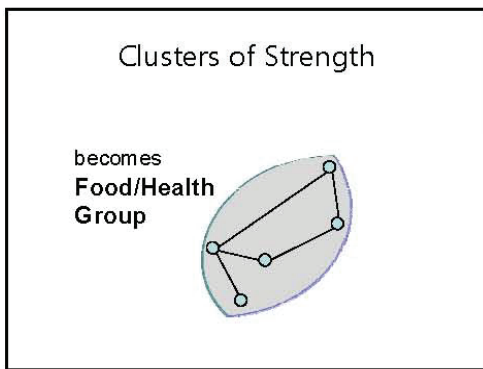
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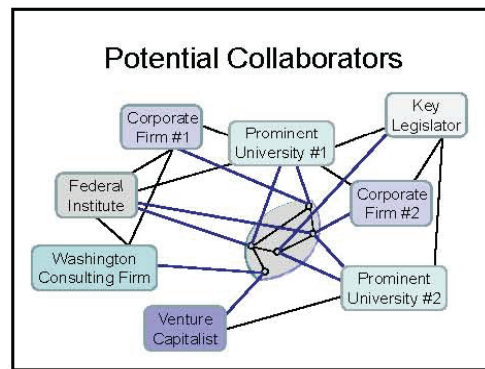
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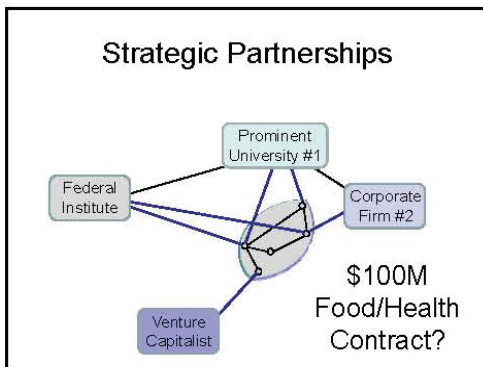
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The Quest for NCI Designation and the Power of Vision and Focus

Barbara Atkinson

Executive Vice Chancellor at the University of Kansas Medical Center

I am here today to tell you a story about how the University of Kansas Medical Center has been building a National Cancer Institute (NCI)-designated Cancer Center, and some of the lessons we have learned from this extraordinary quest.

We had already begun this effort when, in his September 2005 convocation speech at the Medical Center, then-University of Kansas Chancellor Robert Hemenway announced that attaining NCI designation for our cancer center was the University's number-one priority.

His dream for Kansas, he said, "is nothing short of ending suffering and death from cancer."

A cancer survivor himself, Chancellor Hemenway understood the scope of the challenge. Cancer is the second most common cause of death in the United States. This year, it's estimated that more than 1.5 million people will be diagnosed with cancer in the United States – more than 13,000 in Kansas. More than 5,200 Kansans died of cancer in 2008.

Obtaining NCI designation was, the Chancellor said, "our university's number-one priority." Then he repeated it. "Notice I did not say the *Medical Center's* number-one priority. This initiative will require the resources of our entire University."

Chancellor Hemenway promised that KU would build its cancer center "not as a fortress but as a broad network of

resources." To secure those resources, he promised to work with elected officials at the state and federal levels and to enlist the KU Endowment Association, along with private citizens, foundations and corporations to become our partners.

This was excellent news for us at the Medical Center. Fighting cancer was our priority because it touches so many lives – and because it affects every organ of the body, so many of our researchers could engage in the fight. And patients in our region had to travel too far to reach an NCI-designated center, which offers the most cutting-edge clinical trials.

Fighting cancer was also a high priority at The University of Kansas Hospital, with whom we share a campus, physician-scientists and other resources. This gave us the advantage of being able to link clinical programs with science.

And we were poised for a bi-campus effort, particularly because the University of Kansas School of Pharmacy in Lawrence had invested in state-of-the-art technology to quickly discover and develop new drugs.

There was, however, a problem.

Fighting cancer was now the entire University's top priority – but in financial terms it was still mostly a dream. Following the Chancellor's speech, there would be no sudden infusion of research funding or money to build new labs. It would be largely up to us to meet the challenge.

I had come to the University of Kansas Medical Center in 2000 from Philadelphia, a city with four NCI-designated centers. Kansas had none. And very few KUMC faculty had ever led an effort to create an NCI-designated Cancer Center.

We had done the math on what it would take to build an NCI-designated Cancer Center, and we knew that it was going to take a billion dollars. But an analysis provided by the Kansas Technology Enterprise Corporation showed that, 10 years after achieving designation, that initial \$1 billion investment would return \$1.3 billion to the Kansas economy every year.

It was time to lead.

Focusing on: Strengths and Uniqueness

I understood that the NCI would not award us a designation simply because Kansas didn't have such a center. We would need to develop a cancer center unlike any other. Fortunately, we had already been building areas of unique expertise.

The University of Kansas Medical Center had been working on cancer since 1969, with the establishment of the first American Cancer Society Professor of Clinical Oncology and financial support from the Kansas Masonic Foundation. During the early 1970s, the NCI awarded us funding to investigate the feasibility of

establishing a clinical cancer research center in Kansas. By the 1990s, what was then known as The University of Kansas Cancer Center (KUCC) was experiencing steady growth in terms of funding and pioneering research. Such growth warranted formalizing the KUCC's research arm as the Kansas Cancer Institute.

Three things would make The University of Kansas Cancer Center unique: 1) our expertise in drug discovery, development and delivery; 2) our strong research in cancer prevention and control; and 3) the development of a community-based approach to cancer research through the creation of the Midwest Cancer Alliance.

To make this vision a reality, we needed a dynamic, experienced leader. In 2004, the Kansas Masonic Foundation made a new pledge to raise \$15 million to support cancer research over five years. That allowed us to recruit our Center's first full-time director, Roy A. Jensen, MD, a nationally recognized breast cancer researcher and pathologist from the NCI-designated Vanderbilt-Ingram Cancer Center.

Dr. Jensen's arrival fulfilled one essential criterion for NCI designation: "The director should be a highly qualified scientist and administrator with leadership experience and institutional authority to manage the center and further its scientific mission and objectives."

Surely his decision to leave Vanderbilt was made easier by the fact that he was coming home. Dr. Jensen was born in Gardner, Kansas, and earned his bachelor's degree in biology and Chemistry from Pittsburg State University. Dr. Jensen is also a Mason. Recognizing the

organization's more than 30 years of support, we renamed our cancer institute the Kansas Masonic Cancer Research Institute.

Dr. Jensen knew he could build on an existing strength, and one of the things that already made us unique.

Some of the country's top drug developers are working in the Departments of Medicinal and Pharmaceutical Chemistry at the University of Kansas School of Pharmacy – the school is currently ranked number two among all Schools of Pharmacy in National Institutes of Health (NIH) funding and has been within the top five for the past eight years. These drug developers include Jeff Aube, PhD, whose laboratory focuses on the development of new synthetic techniques, total synthesis, and the study of peptidomimetics. The University also had a Center for Drug Delivery Research, directed by Valentino Stella, PhD. Dr. Stella is a world-renowned expert in pharmaceutical chemistry who holds a prized "Development of Dosage Forms and Delivery systems for Antitumor Agents" contract with the NCI. As a result, more than 40 percent of the discoveries from the NCI's pipeline are made at the University of Kansas. Another asset on the Lawrence campus was the High Throughput Screening Laboratory, which allows researchers at the University to screen large chemical libraries of compounds – a technology more common to the pharmaceutical industry than to a college campus.

Thinking about how to build on this foundation, Dr. Jensen began conversations with Scott Weir, PharmD, PhD, a 22-year veteran of the pharmaceutical industry. In early 2006, Dr. Weir joined The University

of Kansas Cancer Center. With \$8.1 million from the Kauffman Foundation and a challenge match of \$8 million from KU Endowment, we were able to create the Institute for Advancing Medical Innovation, which Dr. Weir now leads. This drug discovery, development and delivery program applies industry best practices, leverages relationships with other institutions and industry partners and demands high performance from highly collaborative project teams.

We had succeeded in creating one of the three elements that will make us unique among NCI-designated Cancer Centers.

Another unique element is the strength of our cancer control and population health program, particularly as it relates to minority and rural populations. We have numerous community-based research projects focused on health disparities. University of Kansas Medical Center researchers are currently investigating enhanced treatment for tobacco use among African American smokers; disease management of smoking in rural primary care; and implementation of the "Health for All" model within the Latino community of Kansas City.

We are especially proud of our success with a smoking-cessation program designed for American Indians. The All Nations Breath of Life program, created in collaboration with the Native community, recognizes and respects that tobacco is a sacred plant to many American Indians and that ceremonial use is entirely different from recreational use. This month, the researchers at the forefront of this work will announce a \$7.5 million NIH grant to establish a Center for American Indian Community Health. In collaboration with

other community partners, KUMC will lead a study of tobacco use, diet and exercise among tribal college students. The grant will also help set up a pipeline to attract American Indian high school and college students to the KU School of Medicine's Masters of Public Health degree program and to careers in public health, working with Haskell Indian Nations University.

The third aspect that makes our cancer center unique is the development of a community-based approach to cancer research through the creation of the Midwest Cancer Alliance.

In 2007, we formed The Midwest Cancer Alliance to bring cutting-edge clinical trials, the latest prevention and screening tools and continuing education opportunities to a region-wide network of hospitals and health care organizations. From the Goodland Regional Medical Center near the Colorado border to the Children's Mercy Hospitals and Clinics in downtown Kansas City, Missouri, we wanted to advance the quality and reach of cancer prevention, early detection, treatment and survivorship methods.

Leading this effort is Gary Doolittle, MD, another native Kansan with deep connections to the rural parts of our state. People throughout the state have great affection for Dr. Doolittle, who brings health care to remote places in Kansas via telemedicine, twice-a-month trips to conduct an oncology outreach clinic at Hays Medical Center in western Kansas and monthly visits to the Horton oncology outreach clinic in the Northeast corner of the state.

Strong in the knowledge that our Cancer Center is distinguished by these three unique and valuable elements, we

proceeded to tell our story over and over again as we set about finding the resources necessary for NCI designation.

Focusing On: Telling the Story and Gathering the Resources

When you have to raise a billion dollars, you absolutely must keep your whole community focused on your strengths and successes.

Some community leaders were already behind us, thanks to our strong presence in a report on economics and education. In early 2005, knowing that Kansas City's future was threatened by a host of serious urban problems, the Greater Kansas City Community Foundation commissioned a blue ribbon task force of nationally recognized leaders to recommend ways the metro could transform itself and become competitive in the new, global knowledge economy.

This task force was led by Benno Schmidt, Jr., PhD, chairman of the City University of New York and of the Edison Schools board, and a former president of Yale University. Dr. Schmidt was joined by a diverse group of national thought leaders who met with hundreds of people and exhaustively studied the region's colleges, universities and statehouses. Having spoken with Dr. Schmidt, I was not surprised when his panel's unflinching report concluded that KU Medical Center would play a crucial role in saving the life of a city. "KUMC is the only academic enterprise in Kansas City with the current capacity to generate a high quality and broad scope of basic research activity in a reasonable time with a high probability of success," he wrote in *Time to Get It Right*. The panel ordered Kansas City's business, philanthropic and political leaders to pour

hundreds of millions of dollars into our effort.

We were also fortunate to have strong leadership from former Kansas Governor Kathleen Sebelius. Gov. Sebelius, a Democrat, was elected governor in November 2002. She had been active in insurance reform, having served as Kansas's insurance commissioner and as a member of the state legislature. She cared deeply about health issues, as was clear when President Barack Obama appointed her Secretary of Health and Human Services (HHS) in 2009. During the 2006 session of the Kansas Legislature, Gov. Sebelius included in her budget for fiscal year 2007 an additional \$5 million to support the development of the KU Cancer Center, highlighting the request in her "State of the State of Kansas" speech at the beginning of the session. With significant bipartisan support, legislators approved the appropriation.

Gov. Sebelius continued to include this appropriation in subsequent years, which kept our efforts highly publicized. Kansas lawmakers continued to approve our \$5 million appropriation each year since. Even during this time of declining revenues and painful cuts elsewhere, Kansas lawmakers understand the enormous potential for return on investment in the knowledge economy. After Gov. Sebelius left to lead HHS, her successor, Gov. Mark Parkinson, continued to support the cancer center appropriation. Moreover, he made the cancer fight easier by pushing for the Kansas Clean Indoor Air Act, which passed this year.

State lawmakers also endorsed one of the more visible signs of our quest. In 2007, State Senator Barbara Allen pushed for legislation to create a license plate to

support breast cancer research and outreach efforts across the state.

Perhaps our most surprising show of public support came during the summer of 2008. In the midst of a heated presidential campaign, supporters of the University of Kansas and Kansas State University – who are usually rivals – made a unified push to pass a 1/8-cent sales tax to support education and research in Johnson County, Kansas. I cannot overstate the significance of this election. In Johnson County, registered Republicans outnumber registered Democrats nearly 2 to 1. This is presumably an anti-tax crowd; moreover, an economic crisis was looming. Still, we found allies in the most unexpected places. For example, State Senator Karin Brownlee, a Republican from Olathe who generally opposes taxes, agreed to be an honorary co-chair of this sales tax campaign.

On November 4, 2008, 57 percent of the voters agreed to help pay for our work. Revenues from the tax will generate \$5 million a year – in perpetuity – for our Clinical Research Center, where we will conduct early-stage clinical trials of drugs in our pipeline.

Additional extraordinary leadership and support has come from the Kansas Bioscience Authority (KBA), created in 2004 with a state commitment of \$581 million to help build world-class research capacity, encourage bioscience startups and expand and attract bioscience industries in Kansas.

Directed by Tom Thornton, who had previously served as president and chief executive officer of the well-regarded Illinois Technology Development Alliance, the KBA has played a pivotal role in the development of the animal research corridor from Manhattan, Kansas to

Columbia, Missouri. The KBA led the effort to secure the National Bio- and Agro-defense Facility (NBAF), a government-run research facility that will develop countermeasures to combat high-consequence biological threats involving human, zoonotic, and foreign animal diseases. Over a 10-year period, the KBA has committed more than \$41.4 million to the Cancer Center NCI designation efforts. This money has funded basic research and clinical trials, allowed us to invest in technologies that expand drug delivery capabilities, significantly enhanced our ability to recruit talented researchers through their eminent scholar and rising star programs, and bankrolled major construction to create state-of-the-art laboratories.

We couldn't just focus on successes, though. We had to solve some real problems.

Focus On: Overcoming Obstacles

At this particular moment, the area's civic and political leaders were acutely aware of the need to ensure a friendly environment for scientific research.

Just five years earlier, cancer survivors Jim and Virginia Stowers had donated \$2 billion to create the Stowers Institute, the country's second-largest privately endowed institute for basic medical research. When some Missourians led an effort to ban early stem cell research, the business community joined with scientists, religious leaders, medical professionals and citizens to campaign for a constitutional amendment protecting such research. Missouri voters passed that amendment in November 2006.

Many of these same leaders also joined us to defeat a bill in the Kansas Legislature

that would have banned early stem cell research. In March 2005, I testified before lawmakers to warn them that if they passed the bill, scientists wouldn't want to come to Kansas. It was risky to speak up in that way, because the Kansas Legislature is often conservative and controls a significant portion of our budget. But it was a bigger risk not to testify. I focused on the scientific and educational aspects of the issue rather than the politics. I also gave well over a hundred "Stem Cell 101" education sessions to policymakers and interested citizens. As it turned out, we had strong support in the legislature and from the Governor.

Still, despite all of the external momentum and support, internally not all of our department leaders understood how the focus on cancer designation would benefit them. We encountered resistance when we had to cut departmental budgets at the same time we were raising philanthropic dollars to recruit cancer researchers. Though the entire university system was enduring painful budget cuts, we needed to continue investing in the Cancer Center efforts. This internal effort required a different kind of focusing. Within the first two years of our quest, I replaced six of the department chairs. By the third year, all but five of our 25 departments had new chairs.

Our plan also required us to create partnerships with hospitals throughout the region. After long, hard discussions, we reached affiliation agreements with numerous hospitals, including a crucial agreement that strengthened our relationship with The University of Kansas Hospital.

Lessons of Leadership: Recruitment, Progress and Accountability

I will end by highlighting just three of the lessons that stand out from the many we have learned while trying to create an NCI-designated Cancer Center at the University of Kansas Medical Center.

First, recruiting is key and takes precedence.

Our key hire was Dr. Jensen. But we also made early mistakes. We hired a renowned lung cancer specialist as our Cancer Center's deputy director, but that didn't work out. That recruitment failure set us back two years.

Early in the process, we recruited junior faculty – they were promising but did not yet have NCI funding. We learned to be more strategic in our recruiting, and began hiring researchers who would bring their NCI funding with them.

And we learned that we can't expect Dr. Jensen to do everything. As the Cancer Center's director, Dr. Jensen had done the critical work of educating the public, which resulted in the widespread support that has sustained our mission and momentum. But we were slow in the equally critical aspect of recruiting world-class researchers to fill key leadership posts.

Eventually we hired a search firm to speed up the recruiting. That might be unheard of in the world of academic medicine – but we have now begun to fill those crucial posts.

Second, recruiting takes incredible resources and enormous collaboration.

In addition to the funds and space committed to this effort by the University – both from the Medical Center and Lawrence campus – we have benefited from the significant resources provided from The University of Kansas Hospital.

Key recruits such as Parvesh Kumar, MD, were made possible with the help of the hospital and its philanthropic gifts. The state of Kansas, the Kansas Bioscience Authority and the voters of Johnson County, who approved the tax for the research triangle, have all provided necessary funding. The Kansas congressional delegation provided needed resources through specific Cancer Center earmarks, which have been aimed at purchasing cancer research equipment. And we are indebted to the numerous philanthropic supporters who have contributed money and time to champion our mission. The pace of fundraising has increased even in difficult economic times.

Even with the many recent recruitment successes on both the Medical Center and main campuses, we still have a few key leadership positions to hire. The total estimated cost of five-year recruitment packages for a deputy director and associate directors of cancer prevention and control, translational research and basic sciences is \$18.8 million. Recruitment is expensive, but it is one of the most critical aspects of our NCI designation application package.

The good news is that we have candidates in the pipeline for all of these leadership positions, and are working diligently and creatively to find the resources necessary to bring these cancer physicians and scientists to our region. The Kansas Bioscience Authority's support has been crucial to our recruitment efforts.

Finally, with so much investment at stake, we have learned that tracking our progress and being accountable to our collaborators is crucial. Sharing our successes and setbacks has helped to build trust among the various stakeholders –

local communities, policymakers, the media and our own faculty.

The NCI has invited us to apply as early as September 2011. A recent report from our External Advisory Board applauds our successes to date – but also suggests that we may need to be flexible in our application date. Given our momentum, however, we intend to stay the course. In fact, we are picking up the pace as we move toward the 2011 submission date.

Earlier this month, we were among the sponsors of a town hall meeting on the new role of academia in drug development and discovery. Along with the Friends of Cancer Research, the Kauffman Foundation, the Kansas Bioscience Authority and the Council for Advancing Medical Innovation, we hosted a well-attended meeting of the minds. HHS Secretary Sebelius gave the keynote speech, and NIH Director Francis Collins, MD,

PhD, and Food and Drug Administration Commissioner Dr. Margaret Hamburg, MD, participated in a panel on how to speed up the process of taking drugs from bench to bedside. Our model was among the examples of how it can be done.

Although the lessons I have shared with you today outline the importance of resources, recruiting and accountability, it is important to keep in mind our end goal, which has guided us from the beginning.

Yes, achieving NCI designation could create to 9,400 new jobs for the state, pump \$1.3 million dollars into our state's economy and almost double the amount of grant dollars for KU Cancer Center researchers. It would certainly bring a great deal of prestige to the University of Kansas. But most importantly, it would mean our families, friends and residents could stay in Kansas to get the highest quality cancer care in the country.

Focus on the Enterprising Researcher to Sustain Research Universities

Kimberly Andrews Espy

Charles Bessey Professor, Associate Vice Chancellor for Research & Acting Dean of Graduate Studies, University of Nebraska-Lincoln

The national conversation about sustaining research universities has focused primarily on changes to federal policies. Several papers in this volume describe primarily central efforts to position their institutions for longer term success. From the perspective of the individual researcher though, sustaining research universities is fundamentally about actions that initiate, enable, and enhance the research enterprise, coupled with those that reduce barriers that get in the way. What is the research enterprise? Fundamentally, the research enterprise is defined by enterprising researchers. With that term, researchers means faculty scholars from all disciplines, where the common denominator is creating something new, be it a book, a performance, an article, a method, a product, or knowledge.

The microcosm of the enterprising researcher can be characterized by four tenets:

- Diverse, Flexible, and Unfettered Pursuit,
- Creativity, Originality, and Innovation,
- Impact, and
- Transformation.

Therefore, in addition to changing national policies and positioning the university for greater competitiveness, complimentary effort to foster the “enterprising” nature at the level of the researcher is an important, but somewhat neglected, facet of sustaining research universities. Enabling researchers to be able to chase down a “hare-brained” idea, to debunk conventional thinking, to develop the

alternative method or approach, which impacts national needs and transforms the field is the key feature of a vibrant, sustainable research university.

What can we do differently to spark and sustain the “enterprising”?

Systematic Selection. Current practices for hiring faculty have not changed substantially in decades, and yet the availability of well researched, valid information on how to effectively recruit, select, and hire has burgeoned. All major research universities are trying to identify and select those faculty who want to receive “tenure for work”, and not hire those who “work for tenure”. Yet, most departments write generic advertisements and passively place them in standard venues, without targeted outreach and recruitment.

Furthermore search committees pore over vitae and positive letters of recommendation, to glean marginal differences in the number of publications or the degree of enthusiasm of the referee. Unfortunately, there is little systematic evaluation of candidate attributes such as motivation, diligence, work ethic, or skills like team building, collaboration, and communication. The research enterprise has changed, gone are the days where a scientist sits in the laboratory in isolation. In order to sustain the enterprise, updated hiring methods to directly assess the enterprising qualities of candidates, and more systematically consider these characteristics in selection, would benefit institutions broadly.

Time to Think. To develop the “out of the box” idea, researchers need time to be enterprising, - to read outside of their area, explore using different tools and instruments, play around with different methods to investigate uncharted areas and envision new applications. In the last decades, the increased demands placed on faculty are not uniformly distributed. Research active faculty at major research universities have stepped up their game in the ever increasingly competitive climate. Researchers are submitting more applications, writing more papers, and training more students. However, the expectations for service and teaching for faculty who are more focused on these important endeavors largely has not changed. At many institutions apportionment is sacrosanct, and once set, does not typically change, despite the variation in interests, skills, and impacts of different faculty and changes

in these across a career. Apportioning faculty responsibilities to best fit skills and interests in a dynamic, flexible manner undergirds an enterprising, sustainable institution.

Reduce Barriers. Researchers spend a lot of time doing tasks other than teaching, service, and research. As the research enterprise has become more complicated, the demands for research compliance and project management has increased. Institutions can do a lot to minimize burden – by retaining adequate funds and providing staff for budget and proposal assistance. Some universities have programs for more centralized assistance with project management and human resources. Typically, researchers are not enthusiastic managers – being free of such concerns is partly why many chose to become university faculty rather than selecting other professional careers outside of academe. Providing full service help supports faculty, who are then less fettered by such concerns and have more time and energy to devote to doing research. By always keeping the perspective of doing research (and not of counting beans or fearing lawsuits), the University of Nebraska-Lincoln, for example, has done relatively small things, like providing electronic forms, pre-populated fields, and remote, 24-hour access, which have made a difference in the perceived hassle by researchers that can easily dampen any enterprising spirit.

Invest in Ideas. Today’s challenges – such as energy, climate change, water, human health - likely will not be “solved” by a single investigator from one discipline toiling in a laboratory.

These problems are simply too big, multi-factorial, and entrenched. Sustaining the research enterprise fosters interactions and collaborations among researchers from various disciplines, who have different perspectives, training and methods, but share a common commitment to the problem or question at hand. Research centers have been the engine of innovation, leveraging individual investigator success and lacing it together in new ways that are greater than the sum of the parts. Such environments allow enterprising faculty to pursue unconventional ideas, use new methods, and have a broader and more transformative impact. The challenge, of course, for the institution is in continuing to strategically invest in existing strengths, while keeping an open and nimble mind to spot new opportunities that can flourish with attention and capital. The University of Nebraska-Lincoln, for example, has several research centers that “make sense” given the geography and history of our state – Nebraska Center for Energy Sciences Research, Water for Food Institute, Center for Plant Sciences Innovation, and the Nebraska Transportation Center. However, the university has realized substantial growth in other areas that contribute importantly to the sustainability of the enterprise, such as the Nebraska Center for Materials and Nanoscience, and also drive economic development in the state.

Feed our Future. Commitment to high quality graduate education is the foundation for sustainable impact of any research university in the long term.

Graduate students often are the “glue” that make interdisciplinary work happen, they learn new methods and bring them into the lab, and go on to propagate the “enterprising” as the next generation of scholars. Yet, graduate study is under subtle attack. Declining budgets result in reduced graduate assistantships, and inequities in the funding model make it more cost effective to hire a technician or post-doctoral fellow than train a graduate student. Irrational drivers of supply and demand lead to admitting a large number of “unfunded” graduate students in some disciplines, and the necessity to obtain support prolongs time to degree. This practice artificially inflates demand that does not match hiring prospects after degree attainment. These realities are in stark contrast to the national conversation centered on the new “knowledge / information economy”, where the demand for technically skilled, advanced credentialed individuals has never been higher. Nationally, research universities have been urged to expand capacity to train more graduate students in the enterprising ways to meet national competitiveness goals. Professors of Practice positions that focus on enterprising instruction and impact have been used successfully to alleviate some of the instructional demand drivers, while enhancing teaching quality. However, the system of graduate student support needs rethinking, with a greater partnership by the federal government. Unfortunately, states or donors do not have the same interests in providing financial support for graduate students as for undergraduates, and yet sustainable models for graduate study are key

element of the research enterprise and strengthening research universities.

In summary, the research university is a direct reflection of its enterprising faculty scholars. Research universities are something less without innovative researchers pursuing new avenues that

might be the next light bulb, model T, microchip, or MRI. Working from the microcosm of the researcher is an important perspective to remember in considering efforts to sustain research universities.

Research and Imagination in the Twenty-First Century: Liberal Arts and Sciences

Danny Anderson

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To think outside the box. To take off the blinders. To “blue sky” about an issue. To connect the dots in a new way. To look at things differently. To see from a new perspective. To use a new lens. These phrases are just a few of the everyday reminders that encourage insightful creativity. It is this range of habits of mind that I evoke with the word “imagination.” Within the context of an international public research university like the University of Kansas, I see the work of the liberal arts and sciences as drivers of the imagination within our research mission. The liberal arts and sciences are foundational for sustaining and enhancing the research mission of public universities in the twenty-first century. And it is the imagination fostered by a liberal arts and sciences education that lays this foundation.

The twenty-first century has begun with a conversation about higher education, mainly focusing on challenges and obstacles. Political and social satirist Grant Snider, in his sketch “The University of Awesome,” caricatures a large research university as a map of campus landmarks, ranging from the “Pit of Parental Expectations” in the foreground through buildings renamed to question their relevance and immediate utility for employment, all the way to the shining city of “Reality” located at the far horizon. The elements parodied in Snider’s drawing are stated more seriously in discussions about tuition, accessibility, and accountability, which are key words used today by policy-makers and consumers. On public television, a documentary like *Declining By Degrees* portrays many of

the challenges and short-comings of the present system. Educational scholar and leader Derek Bok, with his book *Our Underachieving Colleges: A Candid Look at How Much Students Learn and Why They Should Be Learning More*, diagnoses the obstacles for achieving the ideals of a liberal arts and sciences education. In his inaugural address, President Barack Obama voiced the commitment to “transform our schools and colleges and universities to meet the demands of a new age.”

Both the American Association of Universities (AAU) and the Association of Public and Land-Grant Universities (APLU) have weighed in on this conversation as it has related to research universities. Robert Berdahl, President of the AAU at one point speculated on whether the United States would need

“fewer but better” research universities. Peter McPherson, Howard Gobstein, and David Shulenburg, of the APLU, have extensively analyzed the future of public research universities, examining their funding mechanisms and contributions to United State economic development and competitiveness as well as strategies for ensuring their future contributions.

While this conversation is robust, one topic is missing: the role of liberal arts and sciences within public research universities. At the Council of College of Arts and Sciences, there is excellent preparation for this conversation with a brochure of frequently asked questions contributed by Matthew C. Moen. And the American Association of Colleges and Universities has foregrounded the liberal arts in a campaign about American’s promise that will continue through 2015. The *Chronicle of Higher Education* in a special group of articles (5 March 2010) discussed “the new liberal arts” in private liberal arts college, regional state universities, online/for-profit institutions, and honors programs in large state universities. In each of these cases, workforce development and rising enrollment in professional programs are the drivers behind the new liberal arts.

But these FAQs, campaigns, and proposals for the new liberal arts have not yet examined the foundational role of liberal arts and sciences in the public research university. In a large public research university, the college of liberal arts and sciences is usually the

administrative cornerstone for the institution. It serves as a home for many of the general education goals. It provides the breadth and depth of majors sought by students. It provides the key opportunities for directly engaging undergraduates in research with faculty. And its doctoral programs and the research relationship forged between graduate students and faculty are frequently taken as measures of the institution’s stature as a research university. With the foundational importance that the liberal arts and sciences play in this role, it is crucial to understand how they foster the imagination needed to ensure prosperity in the future.

Within a public research university, the liberal arts and sciences are not only foundational in sustaining and enhancing research in these many different forms. They are also the intellectual home for students who seek an education that allows them to learn to think like researchers who can imagine and innovate, that shows them how to test ideas while learning about failure and success when taking intellectual risks, that pushes them to develop original solutions to complex problems, and that propels them to rely upon their imagination when visioning the world of the future. Whereas the OED pushes us to conceptualize “research” as goal oriented, “pursuing a specified thing or person,” the imagination broadens research. The liberal arts and sciences are home to applications and translations, but they are also the dwelling place of basic research that

creates the conditions for future applications and translations.

Journalist Thomas Friedman, in his often cited book *The World is Flat: A Brief History of the Twenty-First Century*, notes that:

Liberal arts is a very horizontal form of education (which is to say, a flat form of education). It is all about making connections among history, art, politics, and science. Yes, we need to be more rigorous in training our young people in math and science, which are the building blocks of so much knowledge. But we also need to be vigilant in upholding the teaching of art and music and literature, because they too are essential for innovation. (316)

Friedman's linkage between liberal arts and sciences (with the juxtaposition of different disciplines and perspectives) and innovation is the combination that I am seeking to evoke with the word imagination. Imagination is creative power, the ability to create what does not yet exist in response to the situations, opportunities, challenges, and problems that confront us. This reality should inform the role of a dean of liberal arts and sciences within a public research university.

As James Moeser reminds us, a university leader is also a cheerleader-in-chief. In this case, the dean of liberal arts and sciences at a public research university is cheerleader-in-chief for the imagination and for the ways that liberal arts and sciences enhance and sustain research. There are multiple ways that this responsibility must be fulfilled vis-à-vis the varied nature of liberal arts and sciences. Here are a few examples that range across the liberal arts and sciences.

- In a world driven by the bottom-line and immediate application, the dean

must not only promote strong translational research in the natural sciences but also defend pure imagination represented by "basic research," defined by the National Science Foundation as "pursuit of new scientific knowledge or understanding that does not have specific immediate commercial objectives...." Research imagination may begin with the known, but it also explores the possible that may not yet be reducible to "immediate commercial objectives."

- In a world made smaller by technology, the differences among cultures and languages can loom even larger. Cultural research, area studies work, and combinations of language and literary studies all advance the global imagination that creates bridges across these differences. As Catherine Porter, former president of the Modern Language Association, has noted, it is through these experiences that students "learn to empathize with people unlike themselves and to imagine themselves in situations unlike their own." Research toward cultural aptitude enhances the global imagination.
- In a world made smaller by technology, humanities research also has a special role to play in sustaining democracy. As philosopher Martha Nussbaum underscores, "the ability to imagine the experience of another [...] needs to be greatly enhanced and refined if we are to have any hope of sustaining decent institutions across the many divisions that any modern society contains" (10). Alongside the scientific and global aspects of the imagination, humanities encourage the moral imagination that sustains civility and helps us understand our complex world.
- In a world made up of multiple and varied forms of expression, research into the arts is fundamental. The arts

give voice, form, and shape to individual yearnings as well as collective aspirations and shared understandings. Creative production and research into the arts informs our understanding of imagination as creative impulse as well as active audience engagement with the construction of meaning through the aesthetic imagination.

- Finally, in a world shaped by data, information, media, and representations, research in the social and behavioral sciences plays a fundamental role in understanding the conditions of our existence. Sociologist Arjun Appadurai analyzes the dynamics of life at the end of the twentieth century and notes: “The image, the imagined, the imaginary—these are all terms that direct us to something critical and new in global cultural processes: *the imagination as a social practice*. [...] [T]he imagination has become an organized field of social practices...” (31).

Taking these ideas one step further, the role of the imagination—fostered through the liberal arts and sciences—is foundational for the goals of professional education, especially as recently articulated by the National Academies in the report *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. The global challenges in cross-cultural relations and understanding, demographic flows, security, energy, environment, communications, trade, and economic interconnections must be addressed by the imagination on the way to creating new realities. As Thomas Friedman notes in his concluding chapter to *The World is Flat*,

imagination is a critical enabler for the United States:

[Imagination] has never been more important than now, because in a flat world so many of the tools of collaboration are becoming commodities available to everyone. So many more individuals have the power to create their own content and globalize it. There is one thing, though that has not and can never be commoditized, and that is imagination—what content we dream of creating. (608-09)

It is the goal of the liberal arts and sciences to propel and energize the imagination, to remove the limits to the content we can dream of creating.

These dreams are crucial for our globe, but they are also crucial for our homes, for the quality of our everyday lives. Writer and thinker Wendell Berry often reminds us to bring the lofty back to the practical, back to our roots. In closing, I want to recast Berry’s words about the mission of education to describe the mission of the imagination when engaged in research. Research and imagination, while directed toward the possible future, are also rooted in the present, in our communities. The liberal arts and sciences are foundational at a research university because the research they promote “in the true sense [...] is an enablement to *serve*... And if this research is to be used well, it is obvious that it must be used some *where*; it must be used where one lives, where one intends to continue to live; it must be brought home” (52, with my modifications). The liberal arts and sciences are an intellectual home for the imagination, and through the

imaginative acts we encourage, we bring our research home to improve our lives.

Works Cited

- Appadurai, Arjun. *Modernity at Large: Cultural Dimensions of Globalization*. Minneapolis: U of Minnesota P, 1996.
- Berry, Wendell. "Higher Education and Home Defense." *Home Economics*. San Francisco: North Point P, 1987. 49-53.
- Bok, Derek. *Our Underachieving Colleges: A Candid Look at How Much Students Learn and Why They Should be Learning More*. Princeton: Princeton UP, 2006.
- Friedman, Thomas. *The World Is Flat: A Brief History of the Twenty-First Century*, 3.0. New York: Picador/Farrar, Straus and Giroux, 2007.
- McPherson, Peter, Howard Gobstein, and David Shulenburg. "Ensuring Public Research Universities Remain Vital." Discussion Draft. Association of Public and Land-Grant Universities. July 1, 2010.
- Moen, Matthew C. "Liberal Arts and Sciences FAQ." Williamsburg, Virginia: Council of Colleges of Arts and Sciences, n.d.
- National Academy of Science, National Academy of Engineering, and Institute of Medicine. *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. Washington, D.C.: The National Academies Press, 2007.
- Nussbaum, Martha C. *Not for Profit: Why Democracy Needs the Humanities*. Princeton: Princeton UP, 2010.
- Porter, Catherine. *MLA Newsletter* Spring 2009.
- Snider, Gary. "The University of Awesome!" *The Kansas City Star* 10 June 2010: 31.
- "The New Liberal Arts." *Chronicle of Higher Education* 5 March 2010.

Reconsidering the Architecture of Research in the Public University

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Among the unique strengths of any research university is a community of faculty members highly skilled and motivated in their scholarly pursuits. Any research community is highly diverse both in areas of scholarship and approaches to investigation. Many members of the research community also contribute significantly to the education and training of undergraduate and graduate students in classroom and laboratory settings. At the University of Missouri (or, as known locally, MU), the research and teaching missions include more than 1,900 faculty and instructors associated with 286 degree programs.

Maintaining research excellence during difficult times

Maintaining strong research programs during periods of economic hardship is difficult but necessary. Indeed, the National Academies' report "Rising Above the Gathering Storm", issued in 2007, emphasized the need not only for preserving, but revitalizing the nation's investment in science and math education as well as in basic research. That need was reinforced in the University Leadership Council's National Best Practice report, "Competing in the Era of Big Bets" (Education Advisory Board, Washington, DC) which emphasized the importance of multidisciplinary research, especially during perilous economic times.

Both reports, as well as many others, point out that basic research is essential to the nation's ability to maintain productivity and innovation;

our economic development depends on basic research. The decline or disappearance of the major industrial laboratories has placed responsibility for conducting basic research in research universities. It is increasingly worrisome that these research universities now have significant competition from other nations even as they experience a relative decline in the core financial support of our public and private universities.

The focus of the ULC's report, *Achieving scale in multidisciplinary research*, points to an important role for collaborative, interdisciplinary approaches to science in weathering economic storms. Research in many – some would say all – of the sciences is increasingly collaborative and interdisciplinary (Wuchty et al. 2007). Solving most modern problems requires more kinds of expertise than single investigators can provide, and the day of

the lone wolf genius is mostly behind us. One can see this trend in the rapidly increasing fraction of scientific publications with more than one (or two) authors (Wuchty et al. 2007). This trend has even spread to the humanities with the advent of digital publishing (Siemens 2009). Assembling research teams and evaluating their performance has become a science in itself (Guimera et al. 2005, Whitfield 2008).

The best research done in our academic institutions is and will be team-based. This offers a strategy for maintaining and even growing institutional research without greatly expanded resource investment. While no one would minimize the importance of individual team members, the success of interdisciplinary teams depends as much on the mix of members and their interactions as on individuals' traits. Producing emergent properties – products and productivity that exceed the sum of individual contributions – is a major justification for forming interdisciplinary research teams. Because the whole can be greater than the sum of its parts, assembling new teams to address different problems can allow institutions to maintain or even excel in research without needing to add major new resources. Engineering careful team building could be an important means of staying ahead in trying times.

Collaborative research as social network

Teams of collaborating researchers comprise a type of complex evolving network (Barabasi et al. 2002). Working together to solve a research or development problem involves and

engages all of the important social interaction principles and skills that any interaction among humans demands. That means that the rules and laws governing networks, most of which apply to any kind of network, are also at work in forming and maintaining research teams (Barabasi et al. 2002). Cooperation is key, and the connections among participants can be encouraged, shaped, and focused on solving any problem. Multi-investigator research collaborations are social networks.

Research networks evolve by preferential attachment, with individuals joining on the basis of forming preferred relationships with other individuals in the network (Barabasi et al. 2002). Such a scale-free network develops as a set of motifs which together give the network its shape, or topology (Milo et al. 2002). Analysis indicates that topological features are critical to network function, that different topologies perform various functions differentially, and that these factors can influence how the network innovates (Obstfeld 2005).

For example, in solving the problem of extinguishing a house fire using water from a nearby lake, the optimal (only) topology for a network of firefighters is a straight line. The bucket brigade is the most efficient way to move water from a single source to a single destination. If a second fire were to break out, it is clear that the bucket brigade would no longer be optimal, and we'd have to rearrange our network of firefighters to accomplish this new, more complex task. Other topologies also have optimal applications. For example, spreading a message via telephone is best

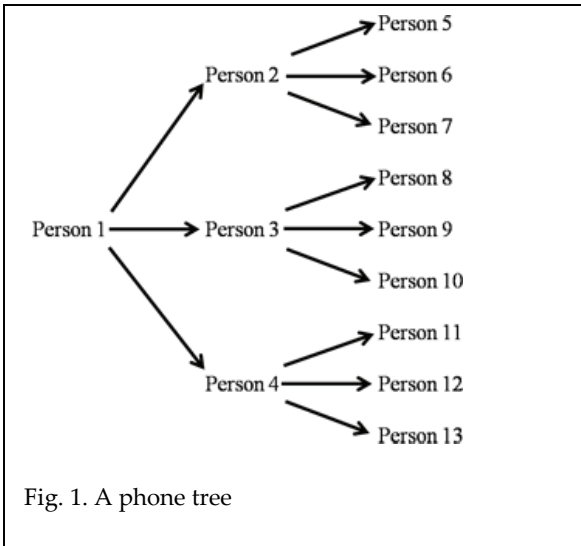


Fig. 1. A phone tree

accomplished with a tree-like network, in which one person calls three, those three each call three more, etc. (Fig. 1). The advantage to the phone tree topology over a bucket brigade in spreading a message is obvious.

Just as certain topologies are ideal for solving certain problems, so does each topology have vulnerabilities (Grubisec et al. 2008). For example, information travels readily between any two adjacent individuals (nodes) in Network A (Fig. 2), but there is no direct connection with non-adjacent nodes. A break between any two nodes severely impacts communication around the network. This problem is resolved in Network B. Network B's greater connectivity produces less impact when a connection is broken.

Breaking links in a network with a topology like Network C produces isolated subnetworks (Fig. 3). Network C is a hierarchical network, typical of the reporting lines of many organizations, including colleges and universities. Its topology constrains information and other flows among nodes within a level. If communication up and down the

network is poor or broken, the end nodes become isolated. This situation is what is referred to as silos in organizations. Lack of connection up and down a topology like C is almost a default condition in large research universities. Awareness of what is happening at the faculty level does not extend beyond the dean level, if it goes that far. The need for an institution-wide perspective and need to address diverse problems prevents higher administrators from staying abreast of faculty research. As a result, links are certain to be broken and the lower units in the hierarchical network become isolated silos. It becomes commonplace for faculty to be unaware of others on their own campus whose work might benefit theirs, or benefit from theirs. This produces duplicated effort and redundant facilities at significant cost, and most importantly, fails to take advantage of the emergent properties of collaboration.

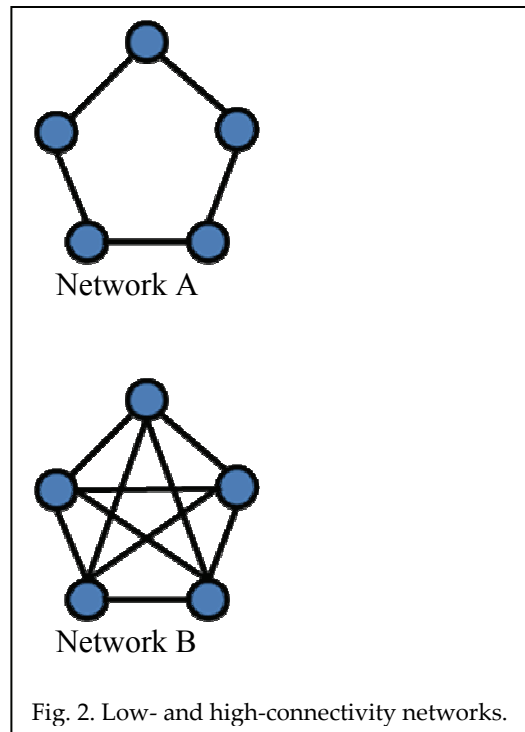
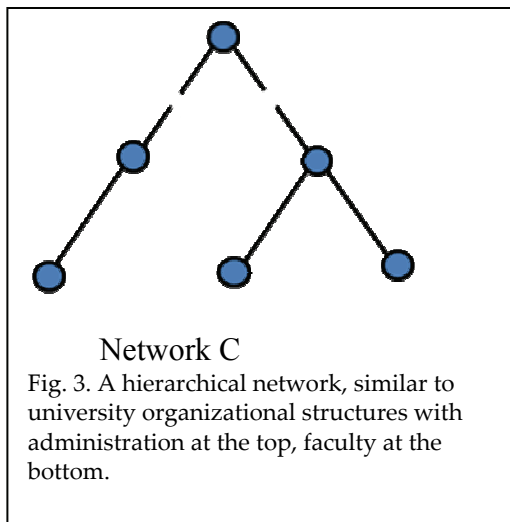


Fig. 2. Low- and high-connectivity networks.



As a result time, effort and money are wasted, something that needs to be avoided as those resources are diminished.

Forming a functional network from silos

Training has not kept pace with changes in modern life sciences research. Employers and investigators identify at least three shortcomings. First, the culture of research training continues to emphasize individual, independent work. While learning to work independently is important, it is equally important today to learn to function as a team member working with others, often across disciplines. Scientific disciplines and sub-disciplines have their own languages and cultures, and while a student cannot receive deep training all of these, working in a collaborative environment can provide young researchers with important social and communication skills, as well as attitudes, needed for the realities of team science.

A second lack is the ability to use computational tools. This is a long-standing problem in the life sciences, arising in part because quantitative

subjects are taught independently of biology from K-12 onward, and because many students interested in biology feel they lack the skills and interest necessary to do well in mathematically-oriented courses. But the life sciences have always employed statistical and modeling approaches, and today use of bioinformatics has become *de rigueur* in many areas of biology. There is frequently a cultural and communication barrier separating not only students, but also investigators from biological and computational backgrounds. Indeed, informatics services are springing up at universities to provide computational analyses for life sciences investigators incapable of doing their own.

A third skill set that is almost never addressed in training researchers is the ability to communicate with diverse audiences, including the public. The difficulty researchers have explaining their work to the public is so widely appreciated it has become a stereotype. But in today's economic and social climate, it is more important than ever to explain results and conclusions, as well as their significance to the people who ultimately provide support. Failure to do this well has contributed to a growing view that science in general and research in particular comprise no more than another special interest group.

In 2009 we became aware of the Howard Hughes Medical Institute's Undergraduate Science Education programs, and realized that we might compete for an undergraduate research training grant to address this situation. While preparing any training grant application is a large, complex exercise,

this one was made more complex by its multidisciplinary nature. The core effort would require the combined expertise of our Bond Life Sciences Center (LSC), the MU Informatics Institute (MUII), and the School of Journalism (SOJ). The LSC exists expressly to foment interdisciplinary collaboration, and it has a history of engaging undergraduates in life sciences research. The MUII is a relatively new organization whose mission includes bringing computational skills to any discipline requiring them, in both education and research. The MU SOJ is nationally-recognized, but in recent years has not invested many resources in science journalism. Finding and engaging interesting SOJ faculty and students (particularly in Strategic Communications, or public relations) would bring excellent communications skills to our research training, and could reinvigorate science journalism on our campus.

To make this coalition work as a coherent program, we also needed expertise in recruiting and managing undergraduates. MU's Life Sciences Undergraduate Research Opportunities Program (LSUROP) exists specifically for this purpose. It manages everything from recruiting to paperwork to housing to locating research laboratories for hundreds of students per year. As do most training grants, the HHMI program requires public outreach, especially to K-12 education. MU's Office of Science Outreach (OSO) is charged with this activity, but its staffing and resources are limited. To extend its reach, we needed the county-by-county organization of the MU Extension

system including 4H, and also engaged a statewide high school education organization, Missouri Partnership for Educational Renewal (MPER).

These core activities required participation by individuals and units from colleges and schools that are widely separated on the MU organizational chart. The outreach functions are located in the College of Education and College of Arts and Sciences. The School of Journalism is its own college. The MUII and LSUROP report directly to the Office of Research (which in turn reports to the Chancellor). The LSC is also in the Office of Research, and its faculty are drawn from 12 departments in 6 colleges. The researchers we hoped to engage would be found in any of the dozens of life sciences-related departments on campus. The Bond LSC served as an integrative hub because of its campus-wide involvement in life sciences research and outreach.

Preparing the proposal also required cooperation and contributions from a variety of administrative offices. The MU grant-writers' network helped coordinate and collect the information needed for the proposal. Matching funds were provided by the Graduate School, Chancellor's office, and the Vice Provost for Academic Affairs, as well as by core participants. Contact with HHMI was managed by foundation specialists in the Development Office.

Most participants from core units had no prior experience or contact with the other participating organizations. Many had never even thought about what some of the other organizations do. The project PIs pulled together these

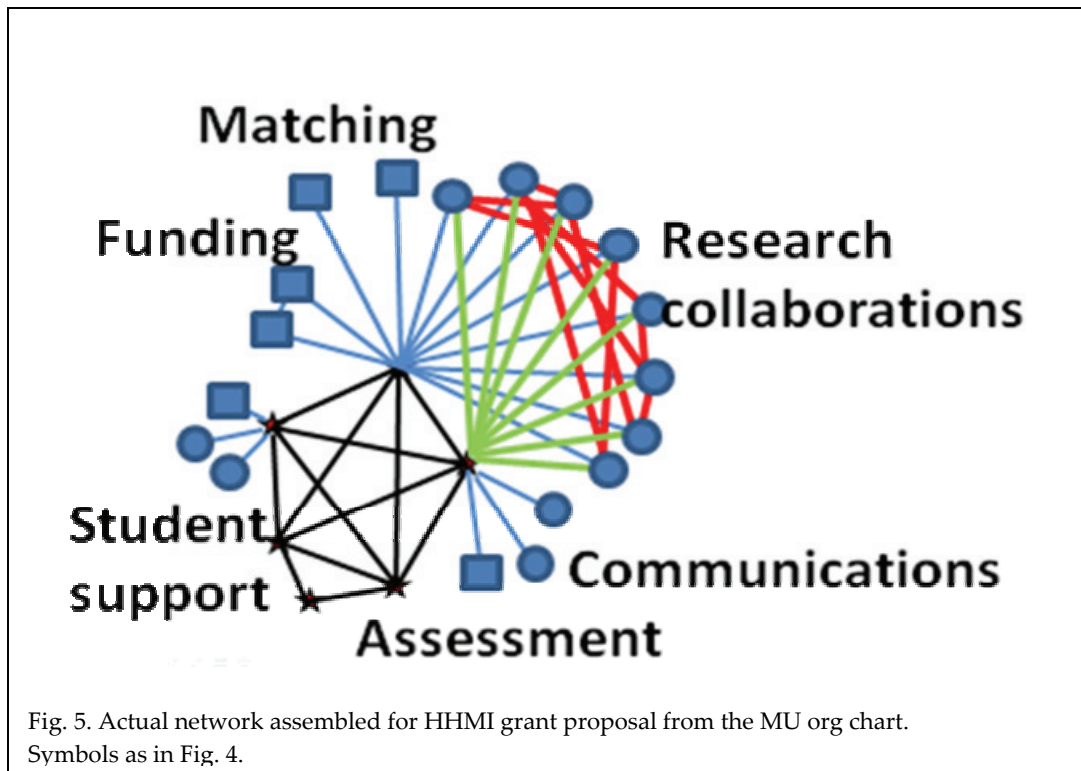


Fig. 5. Actual network assembled for HHMI grant proposal from the MU org chart. Symbols as in Fig. 4.

Engineering university networks

The study of the relationship between network topology and function is now well developed. Network analysts have demonstrated common functional relationship between topological details and outcomes for gene regulation networks, transportation networks, social networks, communication networks, and many others (Milo et al. 2002). Similar or identical topological features produce similar or identical outcomes irrespective of the identities of nodes. Stability of networks to perturbation, efficiency of information transfer, and utility for particular tasks can all be associated with particular network topologies. This implies that networks can be designed – engineered – to maximize the likelihood of a particular outcome.

In this discussion of research networks, the assumed connections among nodes (participating researchers) are some form of communication.

Exchanging ideas, data, solutions, etc. is a fundamental aspect of those interactions. Materials, including funds, reagents, instruments, etc. may also be exchanged following network communication lines. While interactions among units on university campuses may be more complex, nothing can be exchanged without communication. So thinking of interactions in university networks primarily as lines of communication (as opposed to responsibility or reporting) seems useful.

But do networks apart from official reporting lines exist on campuses? Many would like to know, and it is currently popular to try to picture research networks using data mined from repositories many campuses develop, such as coauthored publications, collaborative grants, etc. But it is not clear that these products reflect the network interactions that influence outcomes. While coauthored publications probably represent an

important interaction that shaped an outcome in the past, they do not provide a current view of interactions. Many investigators report that informal interactions that have shaped their work may not culminate in coauthorships. This is certainly true outside the sciences, where sole authorship is the norm, accompanied by lengthy acknowledgements. A lot of research is shaped during informal interaction, even outside of work, which would not be captured by existing incomplete data sets.

Existing university data also are frequently incomplete and out of date. There are many reasons for this, including lack of faculty compliance. Incomplete data not only weaken a network analysis, they may make it impossible. Missing data can eliminate an existing interaction, or even delete an individual from a network graph. This has the effect of changing the rest of the network's apparent topology, which depends on all of the interactions. Missing data do not merely produce a hole in the picture; they can change the entire network picture. Finding out who interacts with whom, and how, is likely to require asking individuals directly, or enticing them to volunteer this information. Unfortunately, existing data sets indicate that voluntary contributions fail to provide the necessary complete information.

So the conundrum is: how can we change a culture of independence to one that recognizes the value of cooperation and information exchange? How can we then shape that culture for maximum impact? A cultural shift like this requires the spread of new attitudes about how

we work and what is useful. The first goal needs to be engineering the spread – an epidemic – of new attitudes.

Studies of social networks have shown that the influence of one individual on others follows network lines and has an impact on individuals up to 3 connections away (3 degrees of separation) (Christakis and Fowler 2009). Many attitudes, behaviors, practices and habits follow this rule; one individual's attitude can spread to others over a span of 3 connections (Hill et al. 2010). Once established in those individuals, they begin to have an impact through their connections, so that the original effect spreads through the network, much like a disease. Obesity, smoking and depression are just three of many outcomes that spread in this way (Christakis and Fowler 2009, Rosenquist et al. 2010).

Some people are more connected than are others; they are called "hubs". These hubs are especially important to network function, since they provide more connections along which information can spread. In most networks hubs are relatively uncommon. Because people join networks (unknowingly) by associating with other individuals (as a 'dyad') most interactions have a lower number of immediate connections. Position in a network also confers significance on particular individuals. One person can provide the link between two larger sets, or two topological features in a larger network; these people are connectors.

In a research setting, investigators who are avid collaborators function as hubs, connecting to many others. They may become hubs because of their

attitude (favoring lots of collaborative activity) or because they are unusually rich in resources (supporting many collaborations) or both. Other individuals may become connectors, perhaps because their interests span interest areas considered to be widely separated (e.g., biology and physics). They may not be in a position to interact with many others, but they do interact with at least one investigator in two otherwise unconnected groups. A crucial trait for an effective connector is the ability to understand two scientific languages or cultures and to 'translate' from one to another.

Hub and connector investigators are highly valuable to a larger research organization, especially where interdisciplinary collaboration is important. They bring different individuals and groups together. And because of their position in the network, they have the opportunity to transmit ideas, approaches and attitudes widely, even creating epidemics. Personality traits are a large component of being a hub or connector, and so should be considered in hiring. Identifying individuals with the attitude and resources that facilitate becoming a hub and placing them into a multidisciplinary environment can create a topology that facilitates collaboration. Individuals may be positioned so that they have the opportunity to form hubs or connections, or interact with influential colleagues. This is, of course, an aspect of what is commonly called mentoring.

Context and physical proximity also are important influences on the spread of influences through a network. A

network's setting can influence outcomes significantly. For example body mass index has been shown to be directly related to a neighborhood's density of restaurants (Raja et al. 2010). Placing researchers in facilities of mixed disciplines with an architecture that encourages casual encounters (such as that of MU's Bond Life Sciences Center) is slowly becoming more common. Physical proximity combined with attention to individual attitudes about collaboration, the composition of expertise and interests, and a mix of more- and less-experienced investigators is likely to maximize emergent, novel research outcomes (Whitfield 2008).

The above scenario – multiple interests and attitudes in physical proximity – runs counter to traditional academic organization on most campuses. Researchers are assigned to space on the basis of presumed shared interests and with no regard for whether they will interact. The definition of 'shared interest' is usually defined as a 'discipline' that dates from the formation of the modern university hundreds of years ago, and minimizes cross-fertilization with other interests and the evolution of new disciplines. Facilities frequently do not permit, much less encourage, interaction, and the interactions are more like tenants of an apartment building than team mates. Worse, a reluctance to allow subjective criteria in hiring and promotion eliminates the opportunity to exploit and propagate attitudes and approaches that could enhance the quality and productivity of the entire group. But an understanding of network structure and function can help manage research

architectures, for example by suggesting strategies for dealing with losses (Matisziw et al. 2009).

Achieving a new research architecture

Some way must be found to flatten the typical university organizational structure with respect to interactions among researchers and to build lines of communication across/among units (Cacioppo 2010). This would increase the efficiency of the research enterprise, and the resulting interactions would allow universities to maintain or increase the quality of research programs even as resources become scarce. It is tempting to use electronic means for this; theoretically a search engine could allow anyone to locate and communicate with others having common interests. For those anxious to make connections, this is a worthy goal. But besides the data problems described above, this presupposes a willingness and desire to make this effort. The current culture on our campuses does not favor this effort, because we still train researchers to work alone, and we support that training with promotion and tenure policies that frequently punish collaboration.

Furthermore, academic units (departments, divisions, colleges), treating resource allocation as a zero-sum game, perceive inter-unit collaboration as a net loss to them. Coauthorships on papers and grants are thought to dilute the unit's impact and reducing credit accruing to it. This is seen as threatening status on campus and even national rankings. It is therefore not in a unit leader's best

interest to encourage interdisciplinary collaboration.

These barriers to a more effective, collaborative research architecture could be overcome by developing new ways of dealing with people, places, and things.

People: Take personality and attitudes into account.

1. Willingness and ability to collaborate or at least work across disciplinary boundaries can be evaluated in new hires. We are often reluctant to use such "soft" criteria in hiring, but when one examines how the behavior of a social network changes, such traits are powerfully influential.

2. Faculty and institutional promotion and tenure committees need to support collaborative research consistently. Institutions must establish policies with respect to how coauthored products are evaluated, and see to it that these are enforced from department to campus-level committees.

Places: Design spaces to put people together so connections are made and concepts spread.

1. Do not assign space on the basis of discipline; that builds silos. Locating researchers on the basis of problems to be solved or other common interests is a promising new idea on university campuses that could become a trend.

2. Design research spaces to encourage informal interactions. Lunch areas or even cafes near research areas keep researchers nearby and encourage conversation. Design meeting spaces of varying

sizes into research facilities promotes both scheduled and opportunistic meetings.

Things: Provide collaborative tools.

1. Most important is a data base that allows investigators to find each other, or organizers to assemble teams. These need to be kept up to date and edited for consistency.

2. Nothing potentiates the formation of collaboration like sitting at the same table. Actively promoting, by organizing, staffing and funding informal meetings allows one to determine whether new interest clusters are viable or not. While this can be done electronically, face-to-face is far more effective.

3. Foster credit- and resource-sharing among academic units so that a win for one is a win for both. Allow shared credit and double-counting on grants. Make sure that all units sharing in a success are acknowledged.

These approaches may defy current values and practices on many campuses, and they require a cultural shift. But with the exception of space assignments, accomplishing them is relatively straightforward and uncontroversial. The key is that once in place, network interactions will spread successful interactions, attitudes, and practices without overt top-down forcing. Arrange the landscape and the network will do the rest, including selecting a topology that maximizes research quality, productivity, and innovation, even in times of tight resources.

References cited

- Barabasi, A.L., Jeonga, H., Neda, Z., Ravasza, E., A. Schubert, A. and T. Vicsek. 2002. Evolution of the social network of scientific collaborations. *Physica A*. 311: 590-614.
- Cacioppo, J.T. 2010. To Keep the Engine of Research Humming, Higher Education Must Rethink Its Organization. *Chron. Higher Ed*. May 23.
- Christakis, N.A. and J. H. Fowler. 2009. *Connected: The Surprising Power of Our Social Networks and How They Shape Our Lives*. Little, Brown & Co. New York. 352pp.
- Grubestic, T.H., Matisziw, T.C., Murray, A.T. and D. Snediker. 2008. Comparative approaches for assessing network vulnerability. *Intern. Regional Sci. Rev.* 32: 88-112.
- Guimera, R., Uzzi, B., Spiro, J., and L. A. Nunes Amaral. 2005. Team Assembly Mechanisms Determine Collaboration Network Structure and Team Performance. *Science* 308: 697-702.
- Hill, A.L., Rand, D.G., Nowak, M.G. and N.A. Christakis. 2010. Emotions as Infectious Diseases in a Large Social Network: The SISa Model. *Proc. R Soc. B* published online before print, doi:10.1098/rspb.2010.1217
- Matisziw, T.C., Murray, A.T. and T. H. Grubestic. 2009. Strategic Network Restoration. *Netw. Spat. Econ.* 10: 345-361.
- Milo, R., Shen-Orr, S., Itzkovitz, S., Kashtan, N., Chklovskii, D., and U. Alon. 2002. Network Motifs: Simple Building Blocks of Complex Networks. *Science* 298:824-827.
- Obstfeld, D. 2005. Social Networks, the *Tertius Iungens* Orientation, and Involvement in Innovation. *Admin. Sci. Quart.*, 50: 100-130.
- Raja, S., Yin, L., Roemmich, J., Changxing Ma, C., Esptein, L., Yadav, P. and A. B. Ticoalu. 2010. Food Environment, Built Environment, and Women's BMI: Evidence from Erie County, New York. *J. Planning Educ. Res.* 29: 444-460.
- Rosenquist, J.N., Fowler, J.H., and N.A. Christakis. 2010. Social Network Determinants of Depression. *Molec. Psychiatry*, forthcoming.
- Siemens, L. 2009. "It's a team if you use "reply all" ": An exploration of research teams in digital humanities environments. *Lit. Ling. Comput.* 24:225-233.
- Taylor, M.C. 2009. End the University as We Know It. *NY Times Op-Ed*, April 27.
- Whitfield, J. 2008. Group Theory. *Nature* 455: 720-723.
- Wuchty, S., B.F. Jones, and B. Uzzi. 2007. The Increasing Dominance of Teams in Production of Knowledge. *Science* 316: 1036-1039.

The University of Kansas Research Engagement Initiative

Steven F. Warren

Vice Chancellor for Research and Graduate Studies, University of Kansas

It is a common expectation that full time tenure line faculty members at research universities devote 40 percent or more of their time engaged in research or comparable creative activities. This expectation, along with the devotion of a substantial effort to doctoral training, sets research universities apart from the rest of higher education. It also makes research universities the most complex and expensive entities in the world of higher education. Given their complexity and cost, the scholarship and creative activities conducted at research universities must over time be able to demonstrate by various measures a substantial impact on society to justify to students, alumni, donors, and taxpayers that their cost and “specialness” is worthy of meaningful levels of tangible support. To assume their value to society is simply self evident, is to invite their own eventual decline into irrelevancy.

Research engagement is an inclusive concept that encompasses scholarly and creative activities. Measures of research engagement include indicators of the outcomes of these activities, such as the number, quality and impact of publications, performances, and other creative works as well as inputs that support research engagement such as sponsored research funding. In the fall of 2008, I led an effort at KU to determine the extent of research engagement by university faculty over the previous ten years as part of larger strategic planning effort conducted by the Office of Research and Graduate Studies on the Lawrence campus. The analysis was limited to our history of obtaining external research funding during the previous decade (1998-2008). We were forced to focus on this narrow input measure because it was the only

reliable indicator we had at that time that was collected university wide and was readily accessible. That limitation aside, our analysis revealed that during the previous decade, despite an impressive 80% increase in total research expenditures, participation by faculty in grant supported research remained remarkably flat at approximately 50% of faculty. Mirroring this, the number of principal investigators on the Lawrence campus hovered around 500 throughout this entire period. Our analyses also indicated that participation by faculty in externally funded research was remarkably uneven within many departments, and for some departments overall external funding was lower than might be expected given the availability of federal programs to support research in their given disciplines.

When Chancellor Bernadette Gray-Little arrived at KU in the fall of 2009, we presented these and other analyses to her. A natural implication of this data was that we could potentially achieve higher levels of research engagement on the Lawrence campus, which might in turn enhance both our scholarly and education missions over the long term. Shortly thereafter Chancellor Gray-Little appointed 19 faculty members to serve on a Research Engagement Task Force (the members of this task force are listed in Appendix A). Professor Kristin Bowman-James and I were appointed co-chairs of this task force. Our charge was straightforward:

- To identify appropriate measures of research engagement
- To suggest specific approaches to promote, increase, sustain, and recognize all types of research engagement by faculty.

During the following months, the Task Force met together on four occasions, held open forums on both the Lawrence and KUMC campuses, and solicited input and feedback on a set of draft recommendations by various means. The final report of the task force was submitted to the Chancellor on March 24th, 2010. It consisted of three recommendations.

1. "It is recommended that the Chancellor charge the Vice Provost for Research and Graduate Studies (KU-L) and the Vice Chancellor for Research (KUMC) with the creation of a comprehensive system for measuring research engagement by KU faculty. The specific parameters measured for each college and school shall be determined in consultation with their respective

deans and with the approval of the Provost or the KUMC Executive Vice Chancellor. The resulting measurement system should provide discipline-appropriate profiles along with their impact on research engagement at all levels: individual faculty member, department, and school or college. Parameters chosen for research engagement must be quantifiable so that the impact of the metrics can be evaluated over time. Measures of research engagement for graduate and undergraduate students and postdoctoral associates are to be identified and assessed as appropriate. An annual KU Research Engagement Report shall be submitted to the Chancellor by the offices of the Vice Provost for Research and Graduate Studies (KU-L) and the Vice Chancellor for Research (KUMC) beginning June 1, 2011, and annually thereafter.

2. It is recommended that the Chancellor charge the dean of each college or school with the implementation of specific actions to promote, increase, sustain, and recognize research engagement by their faculty and students. The specific approaches may vary from department to department and school to school depending on the discipline and other factors. These school-specific efforts should focus, in part, on the identification and reduction of barriers to research engagement. It is strongly urged that future resource allocations be linked in part to the evaluation of

departmental/unit efforts to promote research engagement. Departments with strong records of research engagement and/or effectively promoting research engagement should be rewarded. Deans will be required to submit a brief but specific Annual Research Engagement Support Plan to the Provost (KU-L) or Executive Vice Chancellor at KUMC effective August 1, 2010.

3. It is recommended that the Chancellor, working with deans and other senior administrators, partner with faculty to enhance resources available to achieve and sustain high levels of research engagement. Such resources might include funds to support pilot research, additional research awards in recognition of exemplary research at all levels, enhancement of research infrastructure and support cores, graduate and undergraduate research fellowships, and the availability of special opportunity funds, such as travel awards, among others. Such funds will be collected from a variety of sources, including private donors and external grants and contracts generated by faculty. It is further recommended that the Chancellor, working with deans and other senior administrators, identify ways to remove the barriers and increase the incentives for grant seeking and the pursuit of other such research awards.

In addition to these three recommendations and supporting discussion, it was stated that "Upon

acceptance of this report, the Task Force recommends two immediate actions. First, the Vice Provost for Research at KU-L and the Vice Chancellor for Research at KUMC should be charged with the development of a comprehensive system for measuring research engagement by KU faculty. Second, the Provost and the KUMC Executive Vice Chancellor should meet with their respective deans and begin the implementation of specific actions in support of enhanced and sustained research engagement throughout the university." After review, the Chancellor accepted the report and initiated these two actions. Consequently, KU has begun the process of creating a "comprehensive system for measuring research engagement" and all Deans on the Lawrence campus, and all Chairs at KUMC have been asked to submit their initial plan for sustaining and enhancing research engagement in their respective faculties.

Final Thoughts

The University of Kansas is in the early stages of a long term effort to further enhance its research mission across all disciplines. KU presently has a large number of departments, centers, and programs that serve as outstanding examples of what continued research engagement can do: both by its impact beyond the university, and for its students who, because of their high levels of research engagement, are taught by internationally renowned scholars at the cutting edge of their disciplines. These departments and centers, which are often rated by various external entities as among the finest on the planet, possess strong research cultures that work to sustain their efforts over long periods of time. The overall goal of the research engagement

initiative is to sustain these departments and programs while substantially increasing the number of departments engaged at this level across the university.

A sustained effort over many years will be required before the extent of our efforts to do this can be reasonably determined.

**Appendix A: Research Engagement
Task Force Members**

Steve Warren, Chair
Vice Provost/Professor
Research and Graduate Studies/Applied Behavioral Science
Kristin Bowman-James, Co-chair
Director/Distinguished Professor
EPSCoR/Chemistry
Craig Adams
Chair and Distinguished Professor
Civil/Environmental/Architectural Engineering
Jim Calvet
Professor, Biochemistry and Molecular Biology, KUMC
John Colombo
Director/ Professor, Life Span Institute/Psychology
Derrick Darby
Associate Professor, Philosophy
Don Deshler
Director/ Professor, Center for Research on Learning/Special Education
Adam Duerfeldt
Doctoral Student, Medicinal Chemistry
Bob Goldstein
Distinguished Professor, Geology
Susan Harris
Distinguished Professor, English
Leslie Heckert
Professor, Molecular and Integrative Physiology, KUMC

Mary Lee Hummert
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Faculty Development/Communication Studies
Steven Maynard-Moody
Director/Professor
Institute for Policy and Social Research/Public Administration
Sara Rosen
Associate Vice Provost and Dean/Professor
Research and Graduate Studies/Linguistics
Christian Schoeneich
Chair and Professor, Pharmaceutical Chemistry
Ariel Tazkargy
Undergraduate Student, English/Global and International Studies
Paul Terranova
Vice Chancellor for Research and Senior Associate Dean/Professor
Molecular and Integrative Physiology, KUMC
Joy Ward
Associate Professor, Ecology and Evolutionary Biology
Susan Williams
Associate Professor, Chemical and Petroleum Engineering
Bob Collins, Staff/Director
Planning Information and Analysis, Research and Graduate Studies
John Schott, Staff Assistant Director, Institutional Research and Planning
Terry Turner, Staff Director, Planning and Analysis, KUMC

The Water for Food Global Institute at the University of Nebraska: Growing More Food with Less Water – an Opportunity for Collaboration

Prem S. Paul

Vice Chancellor for Research and Economic Development, University of Nebraska-Lincoln

Monica Norby

Assistant Vice Chancellor for Research, University of Nebraska-Lincoln

The Challenge: Global agricultural productivity has increased dramatically during the past 50 years. Fueled by improved crop varieties, new irrigation technologies, and improved agricultural practices, the global food supply has kept pace with a rapidly growing population. Yet, today we face the possibility of global food scarcity.

By 2050, the world population is expected to increase 40 percent, and the demand for food will double. Population growth is just one factor in this increasing demand. Rising incomes in the developing world mean people are eating more meat and dairy products, which require much more grain. Corn, soybeans, and other crops are being diverted to biofuel production in the developed nations. Worldwide, prime agricultural land is being lost to urban expansion. All of these factors are converging to create food scarcity.

This escalating demand on agriculture to produce food, feed, fiber, and fuel will exert intense pressures on the quantity and quality of our water resources. Globally, most fresh water is used to produce food. Agriculture is responsible for 75 percent of all water withdrawals and 86 percent of total human consumptive use, and the vast majority of that water is used for irrigating crops.

Already, water shortages are occurring in many of the world's major food production areas, and in the future burgeoning industrial and municipal demands will shift more water away from agriculture. In a time when

agriculture is being asked to produce more food for a growing population, demand for water is growing, and a changing global climate holds unknown risks. We must grow more food with less water.

The daunting issues surrounding water use are globally important. This is one of the largest and most complex challenges facing our nation and the global community. It demands our best ideas and an interdisciplinary approach, not only to find ways to produce more crop per drop but also to change human attitudes and behaviors that prevent us from using water efficiently.

Although many organizations in government, academia, and the private sector are working to address global water issues and to improve crop production systems, the University of Nebraska recognized that there still is a critical need for a focused global effort to bring together expertise from many disciplines, including basic and applied water and agricultural sciences and economic and behavioral sciences, to conduct research focused on producing more food per unit of water. To meet that need, the University is establishing the Water for Food Institute, a global research, education, and policy analysis institute committed to helping the world efficiently use its limited fresh water resources to ensure the food supply for current and future generations.

Why Nebraska?

For more than a century, the University of Nebraska has been a leader in research on water, agriculture, and the management of critical natural resources. This leadership grew naturally from Nebraska's position as a steward of vast natural resources. The native grasslands and farmlands of Nebraska comprise one of the most productive agricultural areas in the world – a level of production made possible by a wealth of water resources that includes numerous rivers and streams and the High Plains Aquifer, one of the largest aquifers in the world, containing 3.25 billion acre-feet of water, 66 percent of it in Nebraska. These resources enable the state's irrigated crop production, placing it first in the U.S. in irrigated crop acres and fourth in food production, and giving Nebraska global significance as a food producer.

Center pivot irrigation systems were invented in Nebraska, and the state is now home to the world's four largest pivot manufacturers. The state is a leader in innovative policies to manage and conserve surface and groundwater resources. This strong knowledge base developed by the public and private sectors, coupled with a long history of research, education, and outreach focused on water and agriculture, positions the University and its partners to contribute innovative solutions to the global challenges of growing more food with less water and managing limited water resources in a thirsty world.

Developing a Big Vision

The state has historically made significant investments in the University of Nebraska and has continued to do so in challenging economic times. Currently, more than 160 faculty have expertise related to water and food. The University of Nebraska Board of Regents and leaders in agriculture and industry within the state have been extremely aware of both the challenges associated with water and its importance to the state's economic security and to global food security. They challenged university leaders and faculty to think big about what the university can do to provide global leadership to address issues pertaining to water.

A faculty taskforce was formed to discuss issues related to water, map institutional expertise in those areas, and develop a vision for moving forward. The committee recommended that we establish a global institute with a focus on water for food production. As a first step, they recommended we hold an international conference to better learn

about the challenges and to gather input from diverse experts in food and water on the need for such an institute and the ways to organize it. The Future of Water for Food Conference was held in May, 2009, and co-hosted by Jeff Raikes, CEO of the Bill & Melinda Gates Foundation and James B. Milliken, President of the University of Nebraska. It was co-sponsored by the Robert B. Daugherty Foundation and the University of Nebraska Foundation.

The conference brought together more than 230 scientists and decision-makers representing universities, industry, government, and non-governmental organizations from throughout the U.S. and five other countries. Conference participants addressed many aspects of the essential linkages between water and food and the most pressing issues – overuse, underuse, and inefficient use of water; water quantity and quality; water scarcity; sustainability of the resource; distribution and demand conflicts; legal and institutional barriers to management; and others – and offered ideas and recommendations for tackling the challenges.

In the keynote address, Jeff Raikes succinctly framed the issues. Agriculture and water are inseparable, Raikes said. Many approaches to water management have not worked or have been inadequate. Innovative tools and technologies are needed to address five key challenges: overuse of the water resource; underuse of the water resource; inefficient use, in the sense of not maximizing output per unit of water used; changing water demands as economies grow; and changing water

supplies in the face of climate change and other challenges. Other speakers and panel sessions discussed groundwater resources; the economics of water scarcity; the challenges of managing water for agriculture in Pakistan; better tools for managing water; “green water” and “blue water;” improving drought tolerance and nutrition of crops; the importance of developing sustainability; the need to integrate the scientific, economic, legal, and social factors that affect water management and food production; and other issues.

A main goal of the conference was to explore, through a dialogue among these experts, how a global institute addressing water and food security established at the University of Nebraska could develop the programs and partnerships to effectively address these issues. A core group of 65 experts attended a half-day working session following the conference. Some of their key recommendations included:

The area of water for food is growing in importance and no organization exists nationally or internationally that is focusing exclusively on this issue. Nebraska is a good place for such an organization, and now is the right time to establish this institute.

The core mission of the institute should be to answer the question: *how can we produce more food per unit of water?* The answer to this question must be broadly construed and inter-disciplinary – to develop, promote, and disseminate the application of science, technology, education, policy, and human behavior research to this problem.

The right leader (executive director) is critical.

Partnerships – with other universities, governmental agencies, NGOs, foundations, and private sector organizations nationally and internationally – are critical.

Additional information can be found in the *Proceedings of the Future of Water for Food Conference*, available at: <http://waterforfood.nebraska.edu>.

The success of the conference and the invaluable input from these international leaders confirmed the University's mission to build a global Water for Food Institute. NU President James B. Milliken led the effort to develop the concept and find funding for the proposed institute.

Establishing the Water for Food Institute

On April 20, 2010, the University of Nebraska was fortunate to receive a \$50 million founding gift commitment from the Robert B. Daugherty Charitable Foundation to support the global Water for Food Institute. The gift, one of the largest in the University's history, was to create a multi-campus center for research, education and policy analysis relating to use of water for agriculture. Mr. Daugherty, a native Nebraskan, is the founder of Valmont Industries, one of the largest irrigation companies in the world, and is dedicated to pursuing research and technologies that will produce "more crop per drop" and to preserving our freshwater resources.

Two weeks after the gift was announced, the University held the second international Water for Food Conference, supported in part by the Gates Foundation, the Robert B.

Daugherty Foundation, and Monsanto Company. The conference drew more than 300 participants from 13 countries. Jeff Raikes again gave a keynote, saying that he believed the "...Water for Food Institute is going to be an important leader in addressing a crisis in producing food to feed the world." Other leading speakers included Pedro Sanchez of the Columbia University Earth Institute and 2002 World Food Prize laureate; John Briscoe of Harvard's Water Security Initiative; David Molden, Deputy Director General of the International Water management Institute; Robert T. Fraley, Executive Vice President and Chief Technology Officer, Monsanto Company; [U.N. Panjari](#), Secretary, Ministry of Water Resources, India; and 24 others. Many spoke about the Water for Food Institute and posed challenges in research, education, and policy analysis that the institute could undertake. Several potential partnership opportunities arose from the conference.

Water for Food: A Global Institute

The Vision: The Water for Food Institute is a research, education, and policy analysis institute committed to helping the world efficiently use its limited freshwater resources, with particular focus on ensuring the food supply for current and future generations.

Creating the Water for Food Institute is an exciting and extremely challenging endeavor. The expectations, and the visibility, are high. Even with the University's significant depth and breadth of expertise and the funds from the Daugherty Foundation, we know we cannot succeed alone. Partnerships are critical. The Water for Food Institute will

be a “distributed” institute, with a core group in Lincoln and partners throughout the region and the world. These partners may be from other universities, the public sector (foundations, government agencies, NGOs), and the private sector. The Daugherty gift, while very generous, is viewed as seed funding to enable us to build capacity by funding project development, faculty and student exchanges, and educational programs. To really accomplish the institute goals, we must leverage these funds by securing funding from federal agencies, foundations, and others.

The Water for Food Institute will be governed by a board of directors chaired by the University of Nebraska president. An international advisory board will play a role in strategic planning and partnership building, and a faculty advisory board comprising representatives from all four University of Nebraska campuses will engage the various disciplines and intellectual resources of the University with the institute.

The institute will focus its research, education, and policy analysis efforts on increasing agricultural water productivity through developing new technologies, novel and improved crops, innovative management practices, studies of the human dimensions of water use, and advanced decision-making tools and knowledge delivery systems to inform and guide policymakers, managers, and the public. Institute programs will address the needs of production agriculture and translation to small-holder farmers,

irrigated and rainfed agriculture, in both developed and developing nations.

Initial funding will be used for:

- Core leadership positions: executive director, director of research, and director of policy analysis
- International research fellows and visiting scholars
- Graduate fellow and undergraduate scholars programs
- Cooperative research programs
- Academic programs
- Seed grants for research stimulation
- Water for Food online scholarly journal
- Annual Water for Food Conference
- Administration and management
- Marketing and promotion

The Water for Food Institute will be formally established by the University of Nebraska Board of Regents in October, 2010, and the search for an executive director is underway. Discussions and the development of Memoranda of Understanding with potential partners have begun. Initial organizational efforts have included a series of faculty engagement forums to drill down into areas of faculty expertise on all four campuses; elicit ideas and input from the faculty; begin discussions of potential research, education, and policy programs; and challenge them to develop big ideas that will take the institute forward in the next five to 10 years. The work has begun.

Sustaining and Enhancing the Research Mission: A Potential Model for Thinking Big

The course the University of Nebraska pursued in developing and establishing the Water for Food Institute can serve as a potential model for thinking about and doing big things. To sustain and enhance our research mission in these challenging economic times, we cannot afford to narrow our thinking. We began with envisioning how we could address one of the biggest, most critical societal challenges, assessing our strengths, and developing a multidisciplinary approach. We were fortunate in having strong, active leadership from NU President Milliken, who envisioned a system-wide institute, urged the involvement of all four campuses, and tirelessly pursued funding, and UNL Chancellor Harvey Perlman, who recognized the potential and scope of water for food and gave his full support and key resources to pursuing this big idea.

We built our credibility and our network by bringing key partners to campus as visiting speakers and through

the conferences; by traveling to India, Sri Lanka, Stockholm, Delft, and other venues to learn from and engage potential partners; and through the usual routes of attending conferences, visiting federal agencies, foundations, and other potential funding sources.

Perhaps surprisingly, some of the most difficult work lies in engaging and getting buy-in from our own faculty. A great deal of work goes into transforming the “What’s in it for me?” attitude into enthusiasm for what we can build together. But this is the work with the greatest dividends. The excitement and enthusiasm begin to build, and the faculty becomes a powerful force in creating programs and cooperative projects and building partnerships outside the university.

Again, those partnerships are critical. And a big idea like the Water for Food Institute offers a great opportunity for our neighboring universities, who also offer substantial expertise in the use of water for agriculture and a deep understanding of its importance, to partner with us in making a difference on this global issue.

Toward Opportunities for Regional Collaborations in Drug Discovery in the Midwest

R. V. Duncan

Vice Chancellor for Research, University of Missouri

Midwest universities have become research powerhouses in their own right, but large centralized investments to enable competitive positions in capital intensive activities such as drug discovery and licensing have remained generally at larger universities that exist typically along the coasts. Here we propose a new regional collaboration in cloud bio-computing, shared core facility support, transgenic animal model development, and clinical trials that will compete successfully with other drug discovery activities elsewhere in the United States, and throughout the world. The west-central region of Missouri and the eastern region of Kansas have successfully established themselves internationally through regional development non-profits as the world's 'Animal Health Corridor'. Here we propose to follow a similar international marketing strategy to gain recognition as a center for human health research and drug discovery.

This will become possible only when truly comprehensive and competitive capabilities have been established through these essential collaborative agreements between major Midwest 'flagship' research universities. It is essential that this effort to secure major drug development deals does not go forward until all capabilities have been established to make a clearly competitive value proposition to the pharmaceutical industry.

Introduction

Over the last several decades the University of Missouri (MU) has invested extensively in the basic biosciences, in comparative medicine, and in transgenic technologies for research animal model development.

Over this same period the University of Kansas (KU) has become very strong in clinical trial development for pharmaceuticals. This naturally leads to an opportunity to build on each institution's strengths collaboratively as we build a world-leading capability in bio-innovation and pharmaceutical development in human health care. Many other institutions in the greater Kansas City area, including UMKC, the major hospitals, and the Kansas City University of Medicine and Bioscience (KCUMB), and for-profit firms, all offer specific expertise that will greatly enable the ability within the Greater Kansas City Region to compete with other bio-innovation centers around the world. Children's Mercy Hospital has

established itself as a center for personal medicine, and St. Luke's Hospital is renowned for their world-class program in stroke prevention and recovery, to include the development of highly innovative catheter systems to remove threatening blood clots from the circulatory system near the base of the brain. KCUMB currently trains more licensed physicians than any other educational institution in Missouri, and they have developed optimized custom facilities to support human medical trials. These outstanding capabilities, coupled with the emergence of a new emphasis on regionalism that is discussed in detail below, promise to create the environment necessary for this region to emerge as the point of choice for drug and human health care development world-wide within the next five years. This, coupled with the expanded regional marketing ability of the Kansas City Area Development Council (KCADC), which successfully branded this region as the Animal Health Corridor world-wide, all indicate that this success is eminently achievable once the regional development has expanded to assure a competitive value proposition in drug discovery to the pharmaceutical industry.

The essential aspect of this regional emergence is that all partners remain focused on the outcome of such a successful collaboration. The issue must never become 'who is getting more than whom' in a particular drug development deal, but rather the collective best allocation of regional resources to out-perform competition along the Coasts. This will require complete transparency in a non-profit organization with even

and equal representation from all participatory institutions. This non-profit would transparently solicit, structure, and propose the parsing of these major deals based on proven ability to perform. It is the ability to represent the collective capabilities of all institutions concerned that will make the Midwest Region more attractive than existing drug discovery operations elsewhere in the United States. We at MU have been approached by numerous international investment groups that are interested in developing a high-tech based drug development effort on the MU campus. Such regional efforts will succeed over the competition if the complementary strengths across the Midwest Region are effectively brought together in a single, external marketing operation. Nothing will prevent each institution's efforts to solicit other business alone simultaneously, but all institutions will need to agree not to interfere or compete with a particular deal that is being negotiated by the non-profit on behalf of all institutions.

Regional Cloud Computing

The KCALSI has worked closely with many Chief Information Officers from institutions within the Kansas City Area to propose a mutual investment in cloud bio-computing, which would meet a major need within the Region for drug discovery, and other applications. This effort, which has been led by Dr. Gary Allen, CIO of MU, will soon propose a structure for such a shared investment across the Midwest Region. Other areas of the United States have found that such cooperative investments achieve a better economy of scale, and we anticipate that this will be realized in the

Great Plains Network as well. IBM has expressed interest in this, and MU has recently won a SUR (Shared University Research) Award to develop cloud computing. Further, I have joined with the MU Development staff and some of our lead research faculty members in a detailed meeting with Mark Dean, Vice President of IBM, and we have agreed that the development of cloud biocomputing is an important shared goal of both IBM and MU. Following this meeting and after further discussions with those mentioned above, MU's CIO Gary Allen, has structured and led a group of CIOs from the University of Kansas, Kansas State University, Mizzou, and the University of Missouri System to develop an expanded regional commitment to cloud biocomputing. Others, including Dr. John Wegman, Head of Computer Science, and Dr. Frank Lee, a Systems Architect, both of IBM, have worked extensively with MU and with the CIOs working through KCALSI to help define a detailed technical vision of what such a cloud biocomputing effort may become in the future.

The development of high-end computing for computational drug discovery, interface data acquisition, management, for bioinformatics of massive amounts of genetic and proteomic data, and applications individually to the advent of personalized medicine, are a current critical missing component of our efforts to develop a Midwest engine in drug discovery. Led by Dr. Gary Allen, the CIOs from Kansas State University, University of Kansas (both their Medical Campus in Kansas City, Kansas and

their main campus at Lawrence), Mizzou, and the University of Missouri System have considered the advantages carefully, and they list the following advantages of such high-end computing to the biosciences and health care of the Midwest Region:

- Evaluating hundreds of thousands of molecules to find the most promising candidates for cancer therapies,
- Analyzing huge data sets that are derived from modern medical and biological imaging technologies, and medical records,
- Modeling how complex biological systems operate and how changes in these systems result in human and animal disease,
- Understanding how the uniqueness of an individual's genetic code can be used to optimize medical treatments through personalized medicine, and
- Developing designs for nanotechnology-based health products ranging from microscopic disease screening laboratories to new formulations for the formulating and delivering therapeutic agents.

A proposal request for funding is being prepared by many major research universities in Kansas and Missouri. Hopefully this Great Plains Cloud Computing effort will fill this regional need.

Shared Core Facilities

The chief research officers of all eleven institutions of higher education, and others from major research non-profits and corporations that attended the Life Sciences Summit in Kansas City in March, 2010, met to address what will

be needed to realize the emergence of the Midwest Region. We agreed at that meeting to convene a meeting of the Core Research Facility Managers from each of our Institutions. Dr. Mark McIntosh, Director of the MU Core Facilities and Chair of the Department of Immunology in the Medical School, will coordinate this meeting in the Kansas City area this Fall. The intention of this meeting will be to determine what core facilities may be shared between institutions, and what facilities may be made available to small start-up companies on a cost recovery basis to make the Midwest Region more attractive to companies in the biosciences that are considering locating in this Region.

Currently MU supports a fully functional Core research capability that is available to enhance the research activities of all our investigators, and many of which are available to collaborative researchers across the state and throughout the world. Some of these core facilities report directly to the Office of Research at MU, and they are documented in detail through web links at: <http://research.missouri.edu/division/cores.htm>. Note that the 800 MHz Nuclear Magnetic Resonance instrument, which is used to infer molecular structure, is unique within the State of Missouri. Other outstanding Core capabilities are located within our Interdisciplinary Research Centers, reporting to the Office of Research through their respective Centers (please see: <http://research.missouri.edu/division/centers.htm>). Many of these core capabilities are unique within Missouri, including the activation and neutron scattering services through MURR (our research reactor at MU), a state-of-the-art mass spectrometer

and x-ray diffractometer at the International Institute for Nano and Molecular Medicine (note: we also have mass spectrometers in Proteomics and X-ray diffraction in the Structural Biology Core, as well as access to the Advanced Light Source synchrotron at Berkeley), and state-of-the-art in vivo imaging facilities for tiny blood vessels and other microscopic tissue at the Dalton Cardiovascular Research Center and for whole animal imaging at the VA Biomolecular Imaging Center. The Bond Life Sciences Center has developed many new capabilities, including a laser-based opto-photonics system that can detect a single metastasized melanoma cancer cell in blood serum, and a new application of an existing compound that is literally thousands of times more effective at treating AIDS than other compounds in the same primate that was responsible for the cross-over infection in humans. The Regional Biocontainment Laboratory (RBL) provides unique facilities for inhalation toxicology studies in laboratory animals, and in imaging laboratory animals in a Biosafety Level 3 Facility. The Interdisciplinary Plant Group (IPG) at MU is among the very best in the world, with thirteen of their faculty members having been elevated to Fellow of the AAAS. This IPG is responsible for the first sequence of the soybean genome, and derived technology from this advance is being used to develop new strains of soybeans and other crops that are resistant to drought and parasites, which increase the value of our harvests by billions of dollars per year. The Transgenic Animal Core Facility and three NIH-funded Animal Resource Centers (Mutant Mouse, Rat and Swine)

at MU are world-class, and supply knock-out genetic technology to researchers throughout the world who need an animal model that is closer to human where it counts in the pursuit of the development of therapies for human diseases, such as the swine cystic fibrosis model.

Other unique research Core facilities and capabilities exist throughout the State of Missouri: The Missouri University of Science and Technology (MS&T) in Rolla operates the state's only gallium focused ion beam device, which is able to cut and shape materials at the atomic level. MS&T also hosts an outstanding capability for analyzing and optimizing the design of the electric power grid across the United States. UMKC has world-class programs in both stroke prevention and treatment, and in the study and development of mineralized tissues for dentistry and orthopedic surgery. Both the Midwest Research Institute in Kansas City, and the Danforth Plant Sciences Center in St. Louis, possess unique capabilities in harvesting oil from microscopic algae, which promises to be an outstanding new source of green energy. Other industries, ranging from Honeywell and Black and Veatch in Kansas City, to Monsanto and Boeing in St. Louis, continuously develop new commercial technologies in collaboration with MU that advance the human condition.

MU has led the way in encouraging a broad sharing of our core capabilities across Missouri. MU currently provides genetic sequencing support for several Missouri academic institutions including Washington University in St. Louis, Missouri State University in

Springfield and Truman State University in Kirksville, and flow cytometry core support for Kansas University's Medical Center in Kansas City, Kansas. MU's transgenic cores provide research animal technology throughout the world. MURR provides more radioisotopes for medical applications than any other reactor within the USA, and many companies, such as ABC Laboratories and those in the MU Life Sciences Incubator, routinely use the MU Core facilities on a full cost recovery basis. Project: Mizzou, which is a collaboration between seven major administrative offices at MU, has been developing a plan to permit these core facilities to be utilized broadly by outside organizations, including businesses, non-profits, and other universities. The Life Sciences Summit, led by MU and hosted by the UMKC campus, set the stage for broad regional collaborations across many states, and initiated the Midwest Bio-Innovation Belt.

In addition, a commercial entity called ABC Labs currently conducts NMR-based molecular stability measurements within the MU core facilities, and they are working closely with MU to expand this core utilization to proteomics and possibly other applications in the future. It is important to note that these collaborations with ABC Labs has helped MU substantially in the development of Good Laboratory Practice (GLP) and Good Manufacturing Practice (GMP) standards within the MU Research Reactor (MURR) core facilities at MU. These standards of GMP and GLP are essential to industry in order to support their efforts to secure intellectual property, and the

establishment of these very demanding standards within our academic cores, provide an opportunity for excellent experiential learning for our students who aspire to move into commercial laboratory research following their degree awards. Such efforts within our cores provide MU with a unique advantage in our quest to engage more substantially with industry. These GLP / GMP standards require roughly one scientist-year of dedicated effort to establish for each core capability, so any university laboratory that makes such an investment should have a long-term commitment to industrial collaborative research to assure a recovery of this extensive investment. MU's investment in these commercial laboratory standards are a central part of our commitment to fee-for-service work arrangements with industry, which in turn makes MU and the Midwest Region much more attractive for smaller start-up biotechnology companies, as well as to more established firms such as ABC Labs.

Conclusions, and Next Steps

Once a substantial capability in both bioscience cloud computing and in shared core laboratory facilities are established within the Midwest Region, the next step will be to get the leading investigators who are active in drug discovery at our various institutions and at KCALSI to meet at each other's locations with a very concentrated focus on how we can specifically build on each institutions' strengths to make the Midwest Region more competitive than other locations across the United States for all aspects of drug discovery. Once such a general agreement is in place between the participating institutions, then the next step will be to take a comprehensive approach to define the Midwest Region as the optimal location for major drug discovery. The close collaborations that emerge from this effort will likely lead to new regional opportunities for additional work beyond drug discovery.

The Big 5 at the University of Kansas Medical Center: Remaining Competitive in Today's Research Environment

Paul F. Terranova

Vice Chancellor for Research, University of Kansas Medical Center

The term 'Big 5' was established as the five established research areas at the University of Kansas Medical Center and includes Cancer, Reproductive Sciences, Neurosciences, Kidney and Liver. Each of these areas is part of the 10-yr vision to enhance and sustain life sciences research at KUMC as described in 'The Time is Now' (<http://www.kumc.edu/evc/TheTimeIsNow.pdf>) and each is an established disease or organ-based Center or an Institute at the Medical Center. However, Cancer, Neurosciences and Liver include faculty at the University of Kansas at Lawrence and other institutions throughout the region.

Each of these Centers and Institutes has common characteristics including 1) a Founder and/or Director with significant accomplishments nationally and internationally and a desire to grow the program 2) Shared Resources that support the research programs 3) Program Grants 4) Numerous pre- and postdoctoral students 5) Consolidated research space 6) External Advisory Board 7) Collaborations 8) Seminar Program and 9) Outreach. Each of these nine areas will be discussed and then a summary of each Center and Institute will be provided.

Founder and/or Director

Each of the Big 5 has a founder and/or a director with significant accomplishments nationally and internationally and a desire to conceive and build new programs and grow existing programs, facilitate research by promoting collaborations and development and use of shared resources, recruit, train and mentor outstanding

students and faculty, and promote basic as well as clinical and translational research. Although each of these founder/director characteristics is important, each is not necessarily equal in importance. In fact, the relative importance of each founder/director characteristic is center/institute-dependent. For example, at the time of establishment of a center or institute, leadership qualities including a nationally and internationally recognized scientist may be quite important in order to impart a high degree of visibility that would help in recruiting outstanding faculty and students. During the established years, when the number of faculty is at equilibrium, facilitating research collaborations and developing new shared resources may quite important.

Shared Resources

Each of the Big 5 has shared resources that support research programs within each Center/Institute as well as non-center/institute members throughout the

university. An important approach in developing and sustaining shared resources is to continually monitor the research needs of center/institute members. Shared resources such as DNA sequencing may have been heavily used 20 years ago but outsourcing of this technology has become more cost effective. Examples of some cores within our university include grant preparation and evaluation, laboratory reagent procurement, medical illustration and drawing, microscopy (electron, laser capture, fluorescent), genomics, proteomics, gene targeting and mouse transgenics, animal behavior assessment and flow cytometry.

Program Grants

Each of the Big 5 has program grants, especially from NIH including collaborative research projects such as U54, P01 and P50 and core based grants (P30). The collaborative research projects usually include the majority of project leaders from within the university but subcontracts are also signed with other collaborative universities. The collaborative research projects (U54, P01 and P50) have research projects similar to R01 grants but each project is related and collaborative. Centers/institutes supported by collaborative research grants have a significant number of established investigators in the field. NIH P30 grants support shared resources and are designed to meet the needs of investigators within a specific program, center or institute. P30 grants include a significant portfolio of R01 grants that require the usage of the shared resources. NIH training grants (T32) include stipend and travel support for pre- and/or postdoctoral fellows. T32 training grants are awarded to those universities that have a significant number of NIH R01 funded investigators that can

serve as mentors to the trainees. T32 training grants are indicative of a mature program. Some of the Big 5 programs have NIH K12 grants that support the development of junior faculty researchers. The K12 provides significant salary support for the junior faculty investigators as well as a research supply budget. Each of the Big 5 also has multiple R01 grants and private foundation grants.

Numerous pre- and postdoctoral students

Each of the Big 5 is continually recruiting students through networking and advertisements at national and international meetings. Although some students may be admitted to the graduate or postdoctoral program on institutional training grants, when possible, students are required to apply for individual pre- or post-doctoral fellowships. All of the students are integrated into the activities of the center/institute including participating on committees, interviewing prospective students and faculty, giving seminars, and mentoring their junior colleagues. Students are expected to participate in the local and national activities of the center/institute by attending scientific meetings and participating in student led organizations associated with various societies.

Consolidated space

Each of the Big 5 have consolidated space including laboratories, shared resources, offices and administrative area. For example, The Cancer Center has 140,000 sq. ft of consolidated space whereas the Reproductive and Kidney Centers have 20,000 sq. ft. each and the Institute of Neurological Disorders and the Liver Center have 14,000 sq. ft. each. Within the center/institute consolidated space promotes scientific interactions and the resulting

collaborations can be significant in the form of joint grants and publications and sharing resources. In addition, the provision of services to the center/institute membership in a central location results in a high degree of efficiency by reducing duplication of resources. Consolidated research and administration also increases the visibility of the center/institute within the university and for invited guests, e.g., seminar speakers, external advisors and review teams.

External Advisory Board

Each of the Big 5 have nationally prominent scientists that assess the overall organization of the center/institute, and its vision and goals, progress, scientific direction and impact, centeredness, and the efficiency of the cores. External advisory board members are also very helpful in reviewing program grants prior to submission to the NIH or other granting agency. Collectively, the external advisors have specific scientific or technical expertise that is components of the center/institute. External advisors also provide assistance in recruiting faculty and students.

Collaborations

Each of the Big 5 has well-established collaborations within the center/institute and university as well as with other universities. Thus, collaborations may be local, national, and international and involve students and faculty that has joint publications and grants and share technologies

Seminar Program including an Annual Symposium

Each of the Big 5 has a seminar program and an annual symposium /workshop. The center/institute invites local, national and international experts who are the plenary speakers. Local students are also invited to speak at the podium, lead sessions

and present posters. A student or faculty member within the center/institute is generally assigned to a plenary speaker to assure their needs are met including transportation, meals, and introductions to other guests. This concierge type service works extremely well for our guests and assures a successful visit. The seminar program and annual symposium increases the visibility of the center/institute, an invaluable component.

Outreach

Each of the Big 5 is involved in outreach that includes other centers /institutes and departments within the university, and the local, national, and international communities. Outreach has an educational component that provides information about the activities of the center/institute as well as a fund raising component to support specific initiatives. Some of the centers/institutes have a newsletter that keeps interested parties informed of their activities.

The following is a brief summary of the goals of each of the Big 5.

University of Kansas Cancer Center (<http://cancer.kumc.edu/>)

The University of Kansas Cancer Center under the Directorship of Roy Jensen, MD has three goals:

Establish a critical mass of basic, translational, and clinical cancer researchers whose scientific productivity will drive the drug discovery, delivery, and development process.

Develop and sustain a Cancer Center culture, infrastructure, and state-of-the-art research facilities that foster the translation of scientific findings into new cancer therapies, and enhanced prevention, control, and survivorship strategies.

Ensure that our cancer drug innovation pipeline benefits cancer patients throughout our region and becomes the model for cancer drug discovery in academia.

The programs with the Cancer Center are Drug Discovery, Development and Delivery, Cancer Biology, Cancer Prevention, and Cancer Control and Public Health.

Institute for Neurological Disorders
(<http://www.indkc.org/>)

The goal of the Institute for Neurological Disorders is to advance neuroscience translational research (bench to bedside) and thus, taking what is discovered in basic science labs and applying it to improve clinical outcomes. The mechanisms by which this is accomplished is by 1) communication, initiating and promoting dialogs between clinicians and basic researchers, 2) coordination, promoting interaction between clinical programs and basic science research, and 3) consolidation, creating teams of basic and clinical researchers with common interests and goals. The Institute has several divisions including Brain Injury and Repair, Neuromuscular and Movement Disorders, Neurodegenerative Disorders, Hearing and Equilibrium Disorders, Female Pain Syndromes, and Cognitive and Behavioral Neuroscience.

Institute for Reproductive Health and Regenerative Medicine (website under development)

The goal of the Institute is to facilitate investigator and especially multi-investigator research initiatives in basic, translational, and clinical research directed toward reproductive health and regenerative medicine. There are four centers within the Institute including Reproductive Health, Maternal-Fetal Biology, Contraceptive & Drug Development, and Stem Cells & Epigenetics.

Kidney Institute
(<http://www2.kumc.edu/ki/>)

The mission of the Kidney Institute is to promote research leading to a better understanding of renal disease and the development of clinical trials ultimately for improved patient outcomes. Research areas include Polycystic Kidney Disease, Glomerular & Vascular Disease, Kidney Development, Chronic Kidney Disease, Bone-Kidney Interactions, and Kidney Cancer.

Liver Center
(<http://www.kumc.edu/livercenter/donate.html>)

The mission of the Liver Center is to bring together, on a cooperative basis, basic science and clinical investigators to enhance the effectiveness of conducting translational liver research. Research programs include nuclear receptor biology, hepatic metabolism/ biotransformation, liver injury and cell growth regulation (cancer, regeneration).

Growing Sage

Susan Kemper

Roberts Distinguished Professor, Psychology
Senior Scientist, Gerontology, University of Kansas

This Merrill Retreat has taught me a lot about the challenges facing our universities and possible solutions to those challenges. I've heard about the role of capital campaigns and political action committees, F&A reimbursement policies, and 'deliverables' and 'consumables.' Most of all, I've heard a lot about recruiting new faculty to fill gaps in our research networks. But once we've aggressively recruited new faculty, with remodeled laboratories, start-up packages, and teaching reductions, what then? We have an impressive array of programs designed to launch the research careers of our junior faculty - but KU, and I assume most of our peer institutions, seem to have few programs in place to sustain and enhance the research of mid-career and senior faculty.

The Provost's website lists the Big 12 Fellowship, the Keeler Intra-University Professorship, and Sabbatical Leaves under "faculty development." With a little more digging, I found some short-term residencies and fellowships offered by the Hall Center and other units. And there is the General Research Fund and other internal monies provided by KUCR including funds to support research-related travel and proposal preparation. The promise of our current focus on measuring research engagement is that it will help us identify ways to support and sustain research engagement and I hope it lives up to this promise and considers how to do so across 20 - 30 - 40 year career horizons.

My concerns are driven in part by my own situation. I've been at KU 32 years. When I started in 1978, I didn't

get any sort of start-up package, I had to make do with a lab room that hadn't even been emptied out of the junk and debris abandoned by its prior occupant, and I never saw a teaching reduction until I bought out most of my teaching obligations using a KO1 award from NIH. While in the past few years, I've enjoyed, and made very good use of, the funds generously provided by the Roberts Endowment to build eyetracker labs, attend workshops on neuroimaging, SEM, and new technologies to support aging in place, most of those in my same cohort have struggled to replace and upgrade research equipment, to adapt out-dated research space to contemporary needs, and to acquire expertise in new techniques and technologies. And many have left KU, enticed away to greener pastures. While we aggressively recruit

and support junior faculty, our current crop of mid-career and senior faculty are often overlooked, yet I want to argue that sustaining the University's research productivity depends on them.

I take the title of my remarks from Winston Churchill who, on the occasion of his 80th birthday reminded us " We are happier in many ways when we are old than when we are young. The young sow wild oats. The old grow sage." I would revise it somewhat to place the emphasis on 'productivity' not happiness. The wild oats sown by the young may fall on non-fertile ground, may be washed away by floods, or fall victim to rust, or smut, or blight. But sage is a hardy plant that struggles to return year after year and my concern is with its cultivation.

Most discussions of research productivity and senior faculty start and end with a consideration of the implications of the elimination of mandatory retirement policies in 1994. And they are almost always coupled with dire prognostications about the aging professorate: aging faculty are assumed to be nonproductive at best. We are criticized for 'consuming excessive salaries,' held responsible for the alarming rise in the costs of health insurance, viewed as dull and obsolete, and damned for blocking the careers of more dynamic, and younger, faculty. These prognostications raise the specter not of a campus alive with dynamic, innovative, and productive young faculty, but one clogged with geriatric professors waving canes in one hand and tattered, yellow lecture notes in the other.

Lest you think this view is itself outdated, consider this recent interview with Paul Romer (Tabarrok, 2009). Romer is an economist at Stanford, specializing in economic growth and he is commenting on the rise in the age of NIH grant recipients: "If we are not careful, we could let our institutions, things like tenure and hierarchical structures and peer review, slowly morph over time so that the old guys control more and more of what's going on and the young people have a harder and harder time doing something really different and that would be a bad thing for these processes of growth and change."

It is not just NIH that is plagued by a changing demographic; another recent review (Alexander & Liu, 2009) called attention to the aging of medical school faculty, urging medical schools to focus on the recruitment and retention of new faculty while managing the financial costs of faculty who "postpone" retirement.

These two issues have received a lot of recent attention in the *Chronicle of Higher Education*, including a recent essay (Phelps, 2010) that argued that "retirement is central to the renewal of the American university." The author went on to urge us to "make a timely retirement alluring..." by inspiring faculty to "envision their retirement."

This is indeed a timely issue. Recently, the *Silicon Valley Mercury News* (Krieger, 2010) reported on "Stanford's graying faculty" highlighting a 74 year old English professor, a 84 year old physicist, and a 79 year old nanotechnologist. The piece included these alarming quotes from

Larry Summers that an aging faculty "is one of the profound problems facing the American research university...It defies belief that the best way to advance creative thought, to educate the young, or to choose the next generation of faculty members is to have a tenured faculty with more people over 70 than under 40." And Stanford's Provost lamented "If too many older scholars prevent the younger generation's advancement, bright students may not go into academia...We really narrow down to a tiny trickle the amount of new people — the new geophysicists, the new economists, or the new civil and environmental engineers," he said. "The health of the research enterprise of the country really depends on getting young people to choose academia as a career."

To return to my agrarian metaphor, to ensure a good crop, the assumption seems to be that we must plow under the sage to make room for the oats. I want to challenge this assumption.

1. Eliminating mandatory retirement did not result in a geriatric faculty. There is actually data on this topic. Some of you may be familiar with an analysis by Holden and Hansen (2000) of the impact of retirement policies on North Carolina's research universities. After extensive analyses, they concluded that late retirements are more than offset by early retirements, the mean age of retirement has not increased, and few faculty are 65 or older.

And the National Survey of Postsecondary Faculty (USDE, 2008) has shown that there has been a right-ward shift in the mean age of faculty but faculty distributions remain "right-censored." There's been no rise nationally in the

numbers of faculty 65 and older — about 4% of faculty are 65 or older and this fraction has been holding steady since the 1990s. Stanford appears to be an exception to this national trend, with 10% of their faculty 65+.

2. The "aging" of the professorate is not a result of faculty members 'postponing' retirement but reflects that 'scarcity' of young faculty members. Holden and Hansen (2000) as well as other surveys (Bland & Bergquist, 1997) have identified a number of demographic changes that affect the age distribution of faculty: our "young" faculty are 10 or more years older on average than those hired in the 1970s and 1980s. Individuals postpone entering graduate school, postpone finishing doctoral degrees, postpone entering the academy for personal, professional, and financial reasons; and we have a variety of policies and practices in place that further serve to 'age' the faculty, not the least of which will be long-term implications of recent hiring freezes.
3. But what I most want to take issue with the assumption that older faculty members are 'nonproductive' and 'noncreative.' This view of the relationship between age and achievement is widely held and deeply entrenched.

It owes a lot to a series of analyses by Lehman (1953) in the 1950s; he charted the relationship between age and achievement in many different domains, from creative contributions to German grand operas and chess championships to publications in psychology and medical specialties like pathology and surgical technique. His consistent finding was that achievement

peaks in the 30s – somewhat earlier in some domains like chess, somewhat later in others like medicine.

However, these data, and lots of more recent data both cross-sectional and longitudinal, have been reanalyzed by Simonton (1997). He's found that it is 'career' age, not chronological age, that determines research and creative productivity. Historically, individuals launched their careers in their early 20s, and following a 10-year period of apprenticeship and training, hit their peaks in their mid-30s. But Simonton's point is that it's that 10-year investment that's critical, not the age at which you launch your career. Simonton has modeled productivity as reflecting 3 parameters: what he terms creative potential, ideation rate, and elaboration rate. Creative potential is a 'free parameter' that varies across individuals – it is the pool of new ideas, concepts, variations, and innovations that an individual can draw upon. Ideation rate varies across disciplines and refers to how rapidly those potential ideas can be combined, implemented, and operationalized; elaboration rate also varies across disciplines and refers to how rapidly those idea combinations can be turned into papers and products. The sciences, humanities, and arts differ in the later 2 parameters, allowing for somewhat later peaks in the humanities and somewhat earlier peaks in the sciences. Simonton has found that productivity peaks at career age of 22, so that if you enter a profession at chronological age of 30, you'll hit your peak at age 52 and your output won't zero-out until age 70.

Simonton has also demonstrated what he describes as the "longitudinal stability of cross-sectional variation in productivity." He explains "those who are the most productive in the early part of the career are also the most productive at the career peak as well as the most productive toward the end of life." Simonton has contrasted 2 explanations for this: an explanation that assumes that early productivity results in the most incentives and rewards and a more parsimonious one that just assumes individual variation in creative potential predicts long-term productivity. He has rejected the first in favor of the second: high creative potential not only drives the age at which you hit your peak, but productivity over your entire career.

Others have also challenged Lehman's view of productivity as taking a sharp downward plunge after peaking in the 30s. For example, Gingras et al. (2008) looked longitudinally at the careers of 13,000 professors from Quebec, tallying up publications and assessing the impact of those publications. They contrasted data pooled across all professors with that from a subset of professors who actually published in their fields. They point out that the proportion of 'active' faculty does decline with advancing age, peaking in the 40s at about 65%, declining to about 50% for those in their 60s. However, they show that "active" professors hit a peak rate of productivity in their 40s and sustain their rate of productivity throughout their 50s and 60s. Their impact is somewhat curvilinear, with their 'best' works

coming both early and late in their careers.

4. And I would add: Aging ain't all bad. As pointed out by a recent survey of academic leadership (American Council on Education, 2008), while 12% of tenured faculty are 61 or older, 49% of university presidents and chancellors are 61 or older.

Finally, let me remind you the findings of Shimamura, Berry, Mangels, Rustings, & Jurica (1995). They assessed the performance of a panel of University of California, Berkeley faculty, between 30 and 71 years of age, on a battery of tests of memory and cognition. They compared their performance to that of a group of well-educated, community dwelling older adults and to that of a group of UC-Berkeley undergraduates. On these tests of processing speed, conceptual learning, and prose memory, they found the 'typical' age-related decline when the community-dwelling older adults were compared to the college students. And they also did so when they examined speed of processing for the faculty members. However, on the tests of learning and retention, they found that the older faculty members did just as well as the younger ones. Similar findings have been reported elsewhere when expertise has been assessed – while general abilities may decline, expertise may be preserved, perhaps through selective optimization, the development of compensatory skills, the formation of highly specialized knowledge, or the deployment of additional effort and practice. Indeed, analyses of the relationship between age and job

performance across a wide range of domains has found a zero relationship (Charness & Krampe, 2008).

So my conclusions should be obvious:

- The elimination of mandatory retirement isn't the problem
- The scarcity of young faculty is a problem
- Productive faculty remain productive
- We can and do age successfully
- We need to adjust our time scales to consider how to support the careers of productive faculty members for 20 or 30 or indeed 40 years.

While we do need to plant and fertilize a crop of young faculty members, we shouldn't just plow under the old. The key to sustaining and enhancing research productivity lies with taking the long-view of research careers as extending well past attaining tenure. The age distribution of our faculties is shifting, in part reflecting global demographics and the 'extension of childhood' and the compression of morbidities as we adjust to the prospect of long lives.

So why DO we value the young? If Simonton is right, productivity and creativity aren't the exclusive domain of the young. I think we value the young because they bring new ideas and new technologies to the academy – ones they have acquired during their recent period of training and apprenticeship. So if we want to support and sustain the research productivity of our mid-career and senior faculty, we need to reinvest in them. I have some suggestions as to how to do so:

1. Let's shorten the interval between sabbaticals, remove the quota, support full-pay for academic year leaves.
2. Let's support on- and off-campus mini-sabbaticals and summer fellowships to enable advanced training in new technologies and techniques for data analysis, digital image analysis, neuroimaging, robotics, comparative effectiveness research, virtual reality simulations, etc. etc. etc.
3. Let's increase technical support on-campus for new technologies and techniques: the digital humanities and research methods/data analysis centers are good starts but we need to expand these centers and develop new ones in key areas in the arts, the social and behavioral sciences, and in the humanities on par with those the biosciences and engineering.

References

- Alexander, H., & Liu, C. Q., (2009). The aging of full-time U. S. medical school faculty, 1967-2007. *AAMC Analysis in Brief*, 9, (4).
- American Council on Education Center for Policy Analysis (2008). Too many rungs on the ladder? Faculty demographics and the future leadership of higher education. Retrieve at : <http://www.acenet.edu>.
- Bland, C., & Bergquist, W. (1997). The vitality of senior faculty members. Snow on the roof—Fire in the furnace. Retrieval at: http://www.eric.ed.gov/ERICDocs/data/ericdocs2sq/content_storage_01/0000019b/80/15/29/3a.pdf.
- Charness, N., & Krampe, R. T. (2008). Expertise and knowledge. In S. M. Hofer and D. F. Alwin (Eds.), *Handbook of Cognitive Aging: Interdisciplinary perspectives* (p. 244-259). Thousand Oaks, CA: Sage.
- Gingras, Y., Lariviere, V., Macaluso, B., Robitaille, J-P. (2008). The effects of aging of scientists on their publication and citation patterns. *Public Library of Science*, 3, e4048-4059.
- Krieger, L. M. (2010). Stanford University confronts the graying of academia. Retrieve at: http://www.mercurynews.com/ci_15480908?n_click_check=1.
- Lehman, H. C. *Age and Achievement*. Princeton, NJ: Princeton University Press.
- Phelps, C. (2010). We need to see retirement as a hiring issue. *The Chronicle Review*, April 30, B11-12.
- Shimamura, A. P., Berry, J. M., Mangels, J. A., Rusting, C. L., & Jurica, P. J. (1998). Memory and cognitive abilities of university professors: Evidence for successful aging. *Psychological Science*, 6, 271-277.
- Simonton, D. K. (1997). Creative productivity: A predictive and explanatory model of career trajectories and landmarks. *Psychological Review*, 104, 66-89.
- Tabarrok, A. (2009). Aging academia. *The Economist*, 16, 31.
- USDE, National Center for Education Statistics, (2008). National Study of Postsecondary Faculty.

Musings from the Research Infrastructure Task Force at Kansas State University

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On January 19, 2010 President Schulz formed the Research Infrastructure Task Force (RITF) composed of 14 faculty, administration and staff. He asked me to chair the Task force, and I readily accepted. With a new president and an even newer provost, I saw the formation of this task Force as a *bona fide* opportunity to lay the foundation for much needed and positive change at the University. The president's charge to the Task Force was to take a broad and overarching approach to determine infrastructure needs for research at the University. We, the Task Force (TF), quickly interpreted this to mean that we should explore the entire basis of research, scholarship and creative activities (RSCA) that form the foundation of a modern, dynamic university.

To pursue our charge, I divided the TF into seven working groups of three to four people to study in depth key subject areas of infrastructure. These working groups were: Administration and Staffing, Equipment and Laboratories, Policies and Procedures, Equity across Disciplines, Graduate Students, Overhead Distribution, and External Interactions. The working groups would pursue their areas by finding data and developing recommendations. The entire TF met every other week to keep everyone informed and involved in the cumulative process. I "floated" among all the working group meetings. This process led us to create and use two surveys: the Faculty Survey which gathered data concerning faculty attitudes for RSCA; lab, office and building space; communal facilities;

graduate students; etc., and a survey to all units requesting brief audits of their sponsored research overhead usage. All these efforts were then distilled to a large series of "findings" and "recommendations". An eighth working group of four, including me, was then tasked to write a report which was discussed at length several times by the entire TF as it evolved to completion. We took great pains to ensure that we said nothing that we could not back up with data and that our recommendations followed logically from the findings. The report was finished in mid June and submitted to the president. He made it public, and it can be found at:

http://www.kstate.edu/president/initiatives/ritf/RITF_final_report.pdf

A major, and not at all surprising, finding is: Kansas State University is a

student-centered, land-grant university where some fraction of the faculty pursues RSCA to various degrees in their fields of specialty. The public perception of K-State retains the student-centered, land-grant descriptors and includes athletics. RSCA are largely ignored or not understood by the general public.

This rather innocuous finding is at the heart of the matter. Who is the faculty member who has not had a non-academic acquaintance ask something like, "What are you going to do this summer, now that you don't have to teach"? In a similar vein it is likely that we faculty have all seen the surprise on our non-academic acquaintances when they discover that in the academic year we only teach three hours a week. We academics find these occurrences and their implied perceptions frustrating because we know that there is so much more to being a good academic than teaching.

Or do we? As frustrating as such perceptions are to a research active faculty member, they may be largely justified because the TF also found the following disturbing facts: At KSU

- A mere 10 units account for ~56% of the University's external support.
- Some units have not even submitted applications for outside funding over much of the last decade.
- Many faculty do not consider RSCA as an integral and essential part of their duties.

Graduate students and the Graduate School are viewed as add-ons

to the main activities of the University and not integral to its mission.

The TF found that there has been an attitude that at K-State we do RSCA **too**, not that we do RSCA, and a general malaise exists that RSCA is not as important as undergraduate education and athletics.

What to do about this dire situation? Here I propose a number of actions that could help greatly to remedy the situation. While my primary cause is the betterment of KSU, the actions I propose could be useful at any university.

We start by defining a university:

A university is a place where a community of scholars can create new knowledge through research, scholarship and creative activities in an unfettered environment and disseminate that knowledge through teaching, scholarly activities, extension and outreach.

The University needs to clearly articulate this definition to the Board of Regents, the State legislature, the faculty (yes, remind the faculty!), the students, and the general population of the State.

With this, a **new culture** that advocates, expects and recognizes RSCA must be instilled from the top down, via the central administration, across all disciplines and units. This new culture must extend beyond the campus through the Foundation and the Alumni Association.

A list of action items is:

- We must make RSCA systemic.
- We must broaden our horizons for funding sources.
- We must elevate the stature of the Graduate School and graduate education and bring

top-notch graduate students to our campus.

- We need centrally-supported, shared research facilities and new or renovated spaces thematically driven as opposed to departmentally structured.
- The Office of Research and Sponsored Programs must better meet faculty research needs.
- Central support is needed for organizing large research programs, archiving and coordinating campus resources (labs, equipment and people), and developing, with the collaboration of the Foundation and Alumni Association, prosperous relationships with a great variety of funding sources.

How do we accomplish these goals? Here again I humbly propose a number of actions that could help.

Use our resources. Perhaps the greatest resource of any university is the faculty. Across the faculty essentially any expertise can be found from quantum theory to starting a technical company, from plant genetics to crop advice, from poetry to publishing. We can solve our problems with our collective knowledge, "Physician, heal thyself"! Moreover, the faculty have a vested interest in improving the university, but they must be coordinated. Proper leadership, from the faculty, must be applied to coherently pursue goals related to the common good.

The faculty have to be properly supported and used. We must reward those who are productive and encourage and seed those who could be more

active. For leadership the faculty could administer the RSCA enterprise as "rotators" into the administration properly compensated for a given duration of time in an area from which they would benefit.

We must encourage and augment collaboration. We must think and hire with an interdisciplinary, i.e., thematic, perspective. We must beware of territorial deans and department heads. We must build a university without walls!

The Foundation and the Alumni Association are major resources typically tapped for undergraduate affairs and athletics. It's time to use their great networks and interpersonal abilities to promote the "rest" of the university. It may well take some effort to get these bodies to buy in to the "new" definition of the university. The foundation should provide a concierge service to corporate entities. The Alumni Association should stress the importance of the research climate for teaching and the fact that post baccalaureate education is a major need in the modern world. Both must carry the banner of research, scholarship and creative activities to the masses and sell these as essential to both the university and to society as a whole.

Finally, let us not forget the synergy that exists in the best universities between teaching and the research, scholarship and creative activities enterprise. Yes, RSCA creates new knowledge for the good of our society. Yes, a viable RSCA enterprise at a university can give non-classroom experience to the students, and thus give them an important "non-academic" perspective. But in my opinion the

greatest synergy comes from the fact that with a viable RSCA enterprise, our students can learn engineering from practicing engineers, poetry from real poets, business from experienced businessmen, and science from research scientists. The insights that these real practitioners have are invaluable and they cannot be found in the textbooks.

Acknowledgement. The Task Force members work very hard, conscientiously and collegially. They are:

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See:

http://www.kstate.edu/president/initiatives/ritf/RITF_final_report.pdf

The Nebraska Center for Virology: Research, Training, Education and Outreach

Charles Wood

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In the ten years since its inception, the Nebraska Center for Virology (NCV) has extended its reach into new frontiers of research and new areas of the globe. Established in 2000 as a National Institutes of Health Center of Biomedical Research Excellence, the NCV won a \$10.6 million, a five-year renewal grant from NIH/National Center for Research Resources in 2005, and was recently approved and funded for another five years of funding to support the infrastructure of the Center.

The NCV provides infrastructure support for researchers at the University of Nebraska-Lincoln (UNL), the University of Nebraska Medical Center (UNMC), and Creighton University – Nebraska’s three major biomedical research institutions.

Research carried out in the center focuses on viral diseases of human, animal, and plant, which include AIDS, neurodegenerative diseases, and malignancies. Researchers in the Center study a number of different viruses, ranging from HIV, herpesviruses to Porcine Reproductive and Respiratory Syndrome virus and the Chlorella viruses. The Center has 37 faculty members and is directed by Dr. Charles Wood, a molecular virologist with co-directors Drs. Howard Gendelman and James Van Etten, and Associate Director Dr. Clinton Jones.

There were a number of new scientists hired in the past seven years, and they have expanded NCV research

into the study of human papilloma virus, a major cause of cervical cancer; the Epstein Barr virus and vesicular stomatitis virus, and new arenas of HIV research, including the evolution and transmission of the widely-spread subtype C HIV-1 in Africa and creation of a novel mouse model that can be used in vaccine development.

The Center also is broadening its international work. Wood and his colleagues conduct extensive research programs in Zambia focusing on the transmission of HIV from mothers to their infants, the relationship between HIV and Kaposi’s sarcoma associated herpesvirus, which is linked to cancer, and the evolution of HIV. As a part of this work, the Nebraska team has built a laboratory and clinic at the Teaching Hospital of the University of Zambia and developed close ties with scientists there.

Training the next generation of virologists, both in the U.S. and abroad,

is a critical component of the NCV's mission and continues to grow. There is an ongoing highly successful program funded by the Fogarty International Program to train Zambian and Chinese researchers on AIDS and associated cancer viruses. The program brings researchers to UNL and UNMC for training and provides in-country workshops. Training focuses on laboratory techniques, clinical disease management and behavioral interventions. The NCV also has established a research training program in comparative viral pathogenesis, funded by NIH, to recruit and train U.S. graduate students, particularly those from minority and underrepresented groups.

The NCV's educational mission extends beyond the scientific community. The Center's work on HIV evolution is included in a National Science Foundation-funded project called Explore Evolution that includes a permanent exhibit at the Nebraska State Museum, traveling museum exhibits that are touring the U.S., and an outreach program for 4-H students in five states. Another project, World of Viruses, recently funded by the NIH Science Education Partnerships Award program, is a multi-faceted educational outreach program that will feature NCV research in public radio documentaries and in "flexhibits" distributed through public libraries and to 4-H programs in 22 states.

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Notes