The Interface of Science and Public Policy

Merrill Series on
The Research Mission of Public Universities

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TABLE OF CONTENTS

MASC Report No. 109

Introduction

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

The ninth annual research policy retreat hosted by the Merrill Center resulted in the papers in this collection; each addresses an aspect of the 2005 topic: *The Interface of Science and Public Policy*. It is the latest effort in the program that brings together 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. This year's topic is the focus from many lively discussions of the research mission of public universities. The public is greatly interested in scientific issues such as embryonic stem cell research, sexual behavior, evolution, and global warming. Scientists are increasingly aware of their responsibility toward the public sources of much of the funding for research. And administrators are at the intersection of advocacy for scientific research and stewardship of the public's support of scholarship and higher education. The retreat provided a timely opportunity to discuss the interface of science and public policy with an eye toward how to move forward in a way that honors public trust and scientific integrity.

The eight previous retreats in the Merrill series *The Research Mission of Public Universities* were the foundation for the 2005 gathering. Our benefactors, Virginia and Fred Merrill, support these conferences. On behalf of the participants, I express deep gratitude to the Merrills for their enlightened endowments. On behalf of the Merrill Advanced Studies Center, I extend my great appreciation for the time and efforts of the participants and in particular to the contributors of this collection of papers who allocated time in their busy schedules for the preparation of the materials that follow.

Twenty senior administrators and faculty attended from four institutions in Kansas, Missouri, and Nebraska; they were joined by members of the Merrill Center board of directors and Robert Woody, KU Counsel in Washington, D.C. Keynote speaker Alan Leshner, CEO of AAAS and executive publisher of *Science*, set the stage by describing the current context for science, society, and public policy from his well-informed perspective. In addition to the invited presenters whose remarks are here

published, other participants served as discussants. Though the discussants' remarks are not individually documented, their participation was an essential ingredient in the general discussions that ensued and in 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. Finally, last year we looked at how the leadership of a comprehensive public university must accommodate the fluid nature of scientific initiatives to the world of long-term planning for the teaching and service missions of the universities. The policy retreat focused on how to meet the leadership challenges, both by noting the successes that have been achieved and by considering ways to leverage the available resources across the universities in the region.

Once again, the texts of this year's Merrill white paper reveal many fascinating perspectives through a frank examination of one aspect of the complex issues faced by research administrators and scientists every day. It is with pleasure that I encourage you to read the papers from the 2005 Merrill policy retreat on *The Interface of Science and Public Policy*.

Executive summary

Keynote address: The Current Context for Science, Society and Public Policy

Alan Leshner, CEO of AAAS and Executive Publisher of *Science*

- The main factors of the broader societal context within which science is imbedded: issues arising within science; government regulations, priorities and funding; relationship between science and the public.
- Major trends within science: ever-accelerating pace of scientific advances; blurring or even demise of traditional disciplinary structure and increasing necessity for research that crosses multiple disciplines; rapid technological advances driving the science that is done, rather than science driving the technology, as in the past.
- The events of September 11, 2001, brought major changes to the context and priorities of American science: restrictions on international travel decreased the number of international graduate applications in the U.S.; national research priorities shifted to national security; and new areas of research received generous funding while traditional areas did not.
- Though a vibrant science and technology (S&T) enterprise is central to the success of a developed country, the traditionally good relationship between science and American society shows signs of deteriorating. Science and its findings are increasing politicized and the public's overall confidence in science appears to be eroding. Historically, S&T have been evaluated primarily on their relative costs and benefits, but are increasingly judged by their relationship to core human values; examples: embryonic stem cell research, the attempt to teach creationism alongside evolution.
- The increased tension between science and segments of society results in increasing attempts by the public and policymakers to shape or modify the research agenda. While in the past science and technology influenced the course of civilization and society, the reverse is now occurring, even to the level of determining what can and cannot be studied. The result is a widening divide between science and society.
- Scientific illiteracy or lack of understanding is not the only cause of the rift. The public often understands the science but does not like what it shows or what it means.
- We must continue to defend the integrity of science, but that is not enough to bridge the divide in the science-society relationship. An open and genuine dialogue with the public can move us from a public understanding model to a true public engagement model and a lessening of the tensions. The best ways to do this are still being explored.
- AAAS is developing a new programmatic center focused on a combination of approaches to improve public engagement with science and technology.

Classified Research and the Open University

Jim Roberts, Vice Provost for Research, The University of Kansas

- Classified research presents several thorny issues for universities: philosophical opinions, publication restrictions, practicality, costs, academic freedom concerns, possible harm to students' educational progress.
- Developing an institutional research policy is hindered by the common practice of collapsing a complex set of questions into a single question to be answered "yes" or "no." Classified research embraces multiple questions, but a policy is often seen to be either for or against it. What is needed is to deal with classified research as a single question, in the true sense of the word, and then tease out the other questions that are contained in the term.

Philosophically, we have the following questions:

- Should an institution engage in research when some or all of the research material/ results cannot be released to the general public?
- Should a university directly support the military/industrial complex, conduct embryonic stem cell research, etc.?
- Should some faculty and students have access to information that others cannot know?

Some people are concerned about having research material that cannot be released to the public, others about supporting the military/industrial complex. Some object to embryonic stem cell research, others to research using laboratory animals. There may be opposition to almost any area of research that one can think of.

Publication restrictions: most institutions accept in principle the Association of American Universities position that member institutions should not accept unlimited scope or time publication restrictions, but allow exceptions.

The requirements of doing classified research: Does it mean we have to have a security force? A building with barbed wire and guards? What costs are there? Who pays? What set of rules are imposed by the federal government?

Can academic freedom and segregating students and faculty into "cleared" and "un-cleared" categories coexist? Are we doing anything that harms a student's progress toward a degree?

In the sense of what "classified" means, we deal with "classified research" every day at our institutions, and there is much information that we do not publish. For example, we conduct human subject research where we release general study results, but not details about the participants. We keep company material private. We release survey data but not data about specific students. National security classified information is really no different. It simply represents data that cannot be released. A particular person's answer to a survey question, or the wingspan of an advanced military airplane are both restricted, meaning classified per se; the data cannot be released to the public without someone else's approval.

Should the university accept a contract or grant with an unlimited delay of publication? At KU, we can accept delays up to a certain period of time, but we simply do not accept a grant or contract that has an unlimited delay. But that is a different question than whether or not we do research that involves national security.

Comparison of 15 institutional research policies found different levels of banning or compliance; a chart on page 12 gives the full results.

I propose a Conduct of Research Policy to replace a Classified Research Policy. In a return to the Jeffersonian ideal, I propose that institutions have a simple statement about academic freedom and research:
Principle I: Free and open inquiry
Principle II: Ability to publish
Principle III: Specified Process for Granting an Exception to Principle II
Principle IV: Protect the students and the campus
Prohibition IVa: Top secret facilities on campus
Prohibition IVb: Classified theses and dissertations
Prohibition IVc: Accepting sponsored agreements with ambiguous language
Prohibition IVd: Sponsored agreements wherein the agreement itself is classified
Prohibition IVe: Disrupting the educational program of a student.

Researchers who abuse the system should be dealt with as are any faculty member who violates the rules. Don't create policies to prevent things a few bad apples might do and thus restrict the rights of everyone else who plays by the rules; deal with the bad apples.

Be careful. Take care that the exceptions do not become the rule. We do not need a Department of Classified Research. Exceptions really do have to be exceptions. Institutional policy should be clear on publication expectations. This is one place *not* to make an exception. Arguing that a faculty member did not publish as much as expected because of conducting research involving classified material should fall on deaf ears. In fact, the opposite should be true.

Summary
- Don't ban classified research just because it is classified; don't ban any type of lawful research.
- Don't even use the term "classified research."
- Promote an environment that expects quantity and quality of publications from faculty. Carefully define a process for considering exceptions; use existing policies to deal with bad behavior.
- Have a "conduct of research" policy that adheres to the principles of free and open inquiry of research, expectation of publication of results, clear process for dealing with publication restrictions in sponsored agreements, and protection of the campus and the students.

Meeting the Science Workforce Challenges in the Post 9/11 Environment

Prem Paul, Vice Chancellor for Research / Dean of Graduate Studies,
University of Nebraska, Lincoln

- *Public policy can either benefit or hamper scientific progress*. Our nation has benefited tremendously from the National Defense Education Act of 1958, which resulted in the creation of NASA. The agency has provided funding for the training of thousands of scientists. Conversely, the increased scrutiny of graduate students post 9/11 has fostered a perception of the United States as an unwelcoming place to pursue graduate studies. Recent changes to the regulations governing the ability of international students to come to the U. S. to pursue graduate training in science and engineering disciplines have resulted in notable declines: from 2003 to 2004, the overall number of applications decreased 28%,

admissions fell 18%, and enrollment dropped 6%. These reductions are attributed primarily to problems international students encounter obtaining visas.

- *The availability of science and engineering (S&E) talent has implications for our global economic competitiveness*. The primary factors in the longstanding U.S. global leadership have been the creation of innovation through research and development (R&D) investments in science and technology and the availability of scientific talent. There is a concern our leadership position may be in jeopardy. A number of Asian and European countries are increasing their R&D investments, thus increasing the overall competition for talent. We as a nation have been depending more and more on the international workforce as the number of American-educated students in science and engineering has been on the decline. Restrictive post-9/11 policies have made it increasingly difficult for interna-tional graduate students and scientists to come to this country, whether it be to pursue graduate study, work as a visiting scientist, or participate in international meetings.

- *Current State of the S&E Workforce*: The percentage of American S&E doctoral degrees awarded to U.S. citizens/permanent residents has been on the decline since the early 1980s. In 1966, 78% of all S&E doctorate holders were born in the U.S.; by 2000, that number had decreased to 61%. In addition, the number of S&E doctoral degrees collectively awarded by European countries has exceeded the number of those awarded in the U.S; the number of Ph.D.s awarded by Asian countries also is on the increase.

- Since 1966, the number of scientific papers published by authors from western Europe has surpassed the number published by authors from the U.S. Unless these trends can be reversed, more and more R&D will go offshore and high paying jobs move to other countries.

- *Talent is Key to Innovation*: The Council on Competitiveness asserted in its workforce study that talent is the nation's key innovation asset and recommended building a strong base for scientists and engineers. The study also concluded the demand for scientists and engineering talent far outstrips supply. The number of jobs requiring technical training is growing five times the rate of other occupations, and the average age of the members of the science and engineering workforce is rising. New entrants into S&E fields are not replacing retirees in sufficient numbers. A quarter of the current S&E workforce members are 50 years of age or older; many will retire by the end of this decade.

- *Where will the talent come from?* Some of the major recommendations of the report from the National Academies COSPUP committee on Policy Implications of International Graduate Students and Postdocs in the United States:
    - *The United States must maintain its current quality and effectiveness in science and engineering; attract the best graduate students and postdocs regardless of national origin; make every effort to encourage domestic student interest in S&E programs and careers.*
    - *The overarching goal for universities and other research institutions should be to provide the highest quality training and career development to both domestic and international graduate students and postdoctoral scholars of truly outstanding potential.*

- Positively, a significant percentage of foreign-born students earning doctorates from U.S. institutions end up staying here, contributing to the nation's S&E innovation and, subsequently, the economy. This number increased to 71% for 2001 Ph.D. recipients.

However, recent trends indicate some countries are aggressively recruiting talent back home by increasing their R&D investments.

- To stabilize and increase our S&E workforce, we must intensify our efforts to prepare and encourage K-16 students to pursue undergraduate and graduate studies in S&E related fields. Special emphasis may need to be placed at the middle school level to keep students engaged. American high school students routinely perform below their peers on international mathematics and science tests. Special incentives similar to the National Defense Education Act initiative of 1958 must be launched to provide incentives to students to pursue S&E education and careers. Incentives also are critical in reaching out to underserved and underrepresented students as they constitute an increasing percentage of our population. The college-age population will be as much as 40% racially or ethnically diverse by the year 2020.

- The United States must attract and train the best domestic and international talent in science and engineering in order to maintain its global leadership position. Without sufficient talent, our ability to provide global S&E leadership is jeopardized.

Public Policy and Research at KUMC

Joan Hunt, Senior Associate Dean for Research, The University of Kansas Medical Center

- Public policy has a major impact on research direction at The University of Kansas Medical Center (KUMC). KUMC research leadership has focused on developing programs that are in accord with the aims and goals of (1) world leaders, (2) agencies in the United States that support biomedical research, (3) the State of Kansas, (4) the Kansas City region, and (5) The University of Kansas Medical Center.

- At KUMC, remaining competitive means staying in accord with funding goals of the NIH; this is critical because the institution receives an additional 47% for facilities and administration in addition to direct research awards, and these funds cover many KUMC needs. Commercialization has additional potential for supporting the costs of running the institution.

- The traditional investigator-initiated approach where researchers designed the goals and worked to learn more about how organisms function so as to improve human health is quickly being replaced with the top-down goal of finding uses for research discoveries that will benefit economic growth. Researchers are falling agreeably into the new pattern because (1) biomedical researchers are strongly committed to improvements in human health and would like to see their work bring better health care, and (2) because of top-down direction, researchers must now focus on translational aspects of their work in order to win research funding to support their ventures into discovery biomedical research.

- As sources of funding for research change, the influence of funding agencies increases. The major point of the first graph (page 22) is that states supply little funding support for research (2%); most (63%) is contributed by government grants and contracts. Because translational research is favored for funding by governments, this drives the aims and goals of research submitted by public agencies. Research not authorized by the government is frequently supported by private foundations (8%) or industry (5%). This is the situation for

KUMC research; the university and state contribute little to research while strong emphasis is placed on acquisition of extramural funding. [Statistics credit: Characteristics of Research Centers and Institutes at U.S. Medical Schools and Universities, 2005, American Association of Medical Colleges (AAMC); full report at www.aamc.org/publications]

- KUMC has competed effectively for extramural research awards. Figure 2 (p. 23) shows that awards and consequent expenditures 1997-2005 have nearly doubled.

- NIH awards comprise half of all extramural research awards to KUMC, and KUMC has received equivalent increases to NIH awards over the same time period across the U.S. (figure 3, p. 23).

- KUMC basic science departments in the School of Medicine have competed more effectively for the NIH-mandated initiatives than have the clinical departments (Figures 4 and 5, p. 24).

- Translational research is well supported in the other two schools at KUMC: the Schools of Nursing (SoN) and Allied Health (SoAH).

- Though the IDeA program supported by NCRR is responsible for the growth in KUMC NIH awards, it is not the only factor. As shown in Figure 6 (p. 25), IDeA funds have contributed substantially to growth of NIH awards to IDeA states, while overall awards to IDeA states are on a significantly steeper trajectory. In Kansas, approximately $75 million has been awarded through the IDeA program to teams at K-State , KU-Lawrence, and KUMC. The magnitude of the IDeA awards influences the drive and direction of research at KUMC, as all program awards are reviewed under the same criteria as other NIH awards.

- KUMC leads the State of Kansas institutions in acquisition of NIH funding (Figure 7, p. 26). Because of the inter-institutional IDeA programs, Kansas researchers across institutions are more likely to be cooperative rather than competitive, as they are in many states.

- KUMC does not have a large contingent of researchers when compared to peer medical centers. As a consequence, the university has chosen to focus on areas where strength has already emerged (Figure 8, p. 27). One major focus is development of an NIH-supported Comprehensive Cancer Center. This program partners with the KU-Lawrence campus through its Experimental Therapeutics Program; drug development for cancer treatments is facilitated by the high throughput screening facility in medicinal chemistry supported by an NIH IDeA grant. Drug development takes place on both campuses: KU-Lawrence is in charge of the chemistry and initial testing, while KUMC handles the clinical aspects (Figure 9, page 27).

- KUMC continues to compete effectively for the funds to facilitate translational research and commercialization, in the new direction for health-related research in the U.S. The university is building a 205,000 sq. ft. biomedical research center to be opened in late 2006, has been actively recruiting 177 replacement and new faculty in the past three years, and has developed more active outreach, community-oriented efforts to acquire additional extramural support.

State and Local Plans to Leverage University Research into Economic Development: You Can't Always Get What You Want and You Don't Always Get What You Need

Lisa Freeman, Associate Professor, Kansas State University

- The Federal Government is the largest supporter of academic-based research in the life and health sciences. In return for this investment of tax revenue, Americans expect steady progress in development of safe and effective diagnostic tests, surgical procedures, vaccines, drugs, and devices. Americans today benefit from both the advances in health-related technology and the economic expansion that result from technology transfer.

- Passage in 1980 of the Bayh-Dole Act served as a major stimulus for expansion of technology transfer by universities and academic medical centers. This legislation gave universities the right to own and license their inventions that result from federally-funded research. Estimates are that university research contributed significantly to the development of 27% of the new products and 29% of the new processes commercialized by pharmaceutical companies in the 1980s.

- In 2003, universities received 3179 new patents and spun off 348 companies, yet there is significant concern that translational research and technology transfer occur too slowly. Intellectual property developed in academic laboratories, but not disclosed nor developed represents a loss to society. At the federal level, recent attempts to remedy this have focused on facilitating basic research breakthroughs and accelerating the speed of translation of those discoveries into clinical practice. One initiative is the NIH Roadmap, with its three major themes: new pathways to discovery; research teams of the future; re-engineering the clinical research enterprise.

- The emphasis of regional and state governments is decidedly more focused on economic health than preventing or curing disease. Numerous regions look towards local research universities to help them become national centers for life sciences research and industry; more than 40 states are pursuing a bioscience agenda as a statewide goal. State strategies for support of the biosciences include tax credits and incentives, direct investments in research, technology and education infrastructure, and improving the business climate for biotechnology start-ups. Though the biomedical research enterprise is widespread and there is growing interest by the states in leveraging university research into economic development, however, only a handful of the largest metropolitan areas in the U.S. have demonstrated success. Of the 51 largest metropolitan areas, nine regions account for the bulk of economic growth in biotechnology. Even these successful biotechnology clusters have produced only modest returns to local economy.

- What determines success and returns on research? The significant challenges facing aspiring regional biotechnology centers include: fostering a climate conducive to university spin-offs on campus and in the community, attracting adequate amounts of venture capital to move an idea from “mind to market”, and developing a local workforce suitable to the life-sciences industry. When local officials assess their potential for success, they may overestimate the adequacy of existing resources and infrastructure, underestimate the time required for return on investment, and thereby foster or fuel unreasonable expectations.

- Realistic consideration of the infrastructure available to support a biosciences cluster must take into account the available research base, capital flow, and labor force. In 2002, the nine established U.S. biotechnology corridors accounted for of 59% of NIH funding, 68% of biotechnology patents, 92% of active biotechnology venture capital firms, and 75% of biotechnology start-up firms. Whereas biomedical research activity became more dispersed during the fifteen years between 1985 and 2000, patents, capital flow and the growth of biotechnology firms became more concentrated over the same time period. Productivity in research and life sciences education is necessary but not sufficient for success in economic impact. See text and Table 1: Research Infrastructure Comparison, p. 32, for more information on the specific communities.

- The pathway to prosperity was not identical for the upstart regions. In each case there was a long term plan built around existing strength and based upon support of sensible strategic partnerships, promotion of private capital investment, and encouragement of local entrepreneurship. These are key components of effective programs.

- In metro areas, including Kansas City, where traditional industries are outside of science and technology, attracting private capital investment may represent the most significant challenge. Biotechnology is both expensive and risky. Funding for early stage technology is difficult to obtain, and this investment gap is worse when market uncertainty is heightened by lack of investor proximity and lack of regional experience with commercialization of academic inventions. In regions like these, it will be important for state and local initiatives to provide support for mid-to-late stage funding for development of products with commercial potential, to offer business development assistance, and to invest in workforce development. Academic institutions and established corporations also have the potential to contribute in these areas. Increasingly, universities are making venture funding and campus-based business expertise available to new life science companies. Innovative corporate partnerships are allowing for enhanced educational opportunities in entrepreneurship and professionalism.

- Managing Expectations: Entrepreneurs and executives are susceptible to cognitive biases that lead to inflated self-confidence and an exaggerated view of their own power to influence complex series of events. Organizational and political pressures to emphasize the positive and downplay the negative contribute to overoptimistic forecasts. The net result is too often a shared unrealistic view of future outcomes for major initiatives. Many strategies to leverage university innovation into regional economic development suffer from this type of "delusional optimism"; the results are flawed decision making and unreasonable community expectations.

- See the full text for a case study of the 2001 formation of the University of Buffalo (NY) Bioinformatics Center of Excellence. The exuberant expectations for the UB Center reflect over-optimism and result directly from the planners reliance on an "inside view." It is likely that more realistic expectations would have been generated by taking an "outside view" and adopting "reference class forecasting."The latter approach ignores the details of the project at hand, and instead uses the experiences and outcomes of a class of similar projects to gauge the current position and forecast the future course. The advantage of an outside view is most pronounced for large scale initiatives where the planners lack experience.

- Precedents that can be used for reference class forecasting exist and are accessible. Comparison data similar to Table 1 can be excerpted from the surveys and reports generated by the Association of University Technology Managers (http://www.autm.net/index.cfm), the US Bureau of Census, the federal agencies that provide research funding to universities (NIH and NSF), TheCenter (http://thecenter.ufl.edu/), and the numerous for-profit and not-for-profit organizations that review the bioscience industry.

- *Implications*: Optimism generates more enthusiasm and commitment than realism. Significant instability and lack of trust, however, may be induced or exacerbated by promoting unrealistic expectations in the context of a state bioscience initiative. In these projects, it is typical for the alliances to be uneasy; the agendas to be in conflict; and the resources to be inadequate. Impatience is common where persistence is needed. Establishing a new biosciences corridor is a challenging, long term proposition. Regardless of where the journey ends, one can expect to encounter a long hard road with many obstacles, detours and potholes. Success will be driven by significant investment in research infrastructure, realistic long-term planning, and management of expectations. Reference List, p. 34-35.

Science and Public Policy: Historically Speaking

James Guikema, Associate Vice Provost for Research, Kansas State University

- This paper examines historical examples where public policy decisions collided with the science research enterprise. I use the perspective of history to focus on two obvious questions – both of which lead to a third item: research compliance concern.

- *Can policy decisions shape the future of science?*
- Yes. Government largely provides the funding for our work, and, despite the concept of peer review, Washington feels free to set our research agendas

- The Kansas Cosmosphere and Space Center (KCSC) tells a remarkable story of the U.S. commitment to the space program. Much of this commitment grew during the Eisenhower presidency and led the way to today's robust science programs. The Eisenhower presidency made a major decision which set the stage for initial losses in the space 'race' but set led to the larger victory.

- The decision had its roots in events during WWII when, in February 1945, Stalin, Churchill, and Roosevelt met to divide Germany. Stalin was ecstatic, since the Russian zone would contain the major weapons and missile development region—Peenemünde. In June 1945, however, Dr. Warner von Braun surrendered to US troops, and Secretary of State Cordell Hull approved moving von Braun, 126 members of his staff, and 300 train cars of V2 rockets and missile parts to the U.S. Stalin was furious and, immediately following the war, launched an aggressive missile development program.

- When Eisenhower assumed the presidency, the Army (von Braun et al.) and the Navy were active in U.S. missile development. Eisenhower added a civilian effort that later became NASA. Von Braun's team was shut out, despite overwhelming superiority, because it was a military, not civilian, operation.

- Then the Soviets launched Sputnik I (October 4, 1957) and Sputnik II (November 3, 1957), and the U.S. lost the space war – part 1. In a complete reversal, on November 7, 1957, Eisenhower announced that the Jupiter program (von Braun's) had solved all of the U.S. problems, and that orbital flight was near. In January 1958, Explorer I was launched, putting into orbit a radiation sensing payload developed by a University of Iowa colleague, Professor James van Allen.

- The U.S. lost phase 1 of the space race because of Eisenhower's pro-civilian policies. Kennedy, however, needed to reclaim international leadership. He asked his staff to recommend strategies, and Lyndon Johnson provided the answer – put a man on the moon. The Apollo program had begun. Would we have gone to the moon if Eisenhower had won the race to orbital spaceflight – I think not.

- *Can (bad) science shape the future of public policy?*
- An historical example of science shaping public policy was suggested by K-State Vice Provost for Research, Dr. R.W. Trewyn: the activities occurring during the Viet Nam war, when the U.S. extensively used defoliants like Agent Orange to deny terrain to the enemy. Little personal protective equipment was used, and adverse conditions such as prop-wash from helicopters did not deter spraying.

- Dr. Trewyn was asked to be a consultant on a study of the health effects on soldiers involved in herbicide application. He was asked to testify to the National Affairs, Veterans Affairs, and International Affairs Subcommittee of the House Committee on Governmental Reform. The focus was on the Air Force Ranch Hands Study on the Health Effects of Agent Orange (March 2000). And his message was this: the study was flawed, because the control group was inappropriate.

- The U.S. government based its treatment of veteran soldiers on a flawed study. Even though the flaws were unearthed, the science team refused to change the parameters during the two decades of the study. Bad science helped to create bad policy.

- *Are there implications for the research administrator?*

- Export Administration Regulations (EAR) are administered by the Department of Commerce to regulate items that could be mutually used for business or for defense (such as global positioning systems). International Traffic in Arms Regulations (ITAR), administered by the Department of State, regulate weapons and related items. EAR violations could result in faculty members being fined up to $1 million and 10 years imprisonment. ITAR violations could result in $100,000 and two years imprisonment. The faculty member, not the university, is personally liable.

- Since 1994, the concept of 'deemed export' has come into play. Simply put, in order to convey restricted information or protected software code to a foreign coworker (undergraduate student, graduate student, postdoctoral, or faculty colleague), one must first obtain an export license. The restrictions come into play when faculty members accept research contracts/agreements which (a) contain limitations on publishing the findings of research, (b) are based on the sponsor providing sensitive or confidential information which will not be published, or (c) is classified by the government.

- EAR, ITAR, and the concept of deemed export mean that universities must add a layer onto their research compliance activities. At Kansas State University, we have begun that process.

Research Compliance Challenges

Robert Hall, Associate Vice Provost for Research, University of Missouri

- Compliance with an increasing number of federal and, to a lesser extent, state laws and regulations consumes resources of all major research institutions at an increasing rate. This also burdens investigators with administrative requirements that compete with their academic pursuits.
- Most institutions seeking federal funding have augmented their human research protection programs, often at the expense of other priorities.
- Animal use in research presents another fiscal challenge.
- Conflicts-of-interest have raised compliance antennae nationwide.
- A recent report suggests that the amount of research misconduct actually occurring at U.S. universities may be underestimated, supporting the ongoing educational efforts focused on a Responsible Conduct of Research (RCR) initiative.
- Related compliance areas currently taking considerable MU time and resources: biological safety and the Institutional Biosafety Committee (IBC).
- Recent federal guidance indicates that all recombinant-DNA research proposals should be reviewed at a convened IBC meeting, and further that such meetings should be open to the public when practicable. Similar compliance committee meetings have not traditionally been open to the public, nor have their minutes been accessible via state open-records law.
- The USA Patriot Act appears to have sufficient congressional support to continue generally un-amended; thus, rules applying to Select Agents will remain a part of research compliance into the foreseeable future.
- Export controls loom as the single regulatory issue in university research compliance with the potential for significant resource allocation in the immediate future. Although current export control regulations have been in place for many years, universities have traditionally relied on what is known as the "fundamental research exclusion" to exempt the majority of research projects from Department of Commerce licensing requirements. In fact, a quick review of existing export control regulations reveals that these are complicated rules administered by three major federal departments: Commerce, State and Treasury.
- Following recent compliance challenges in human subjects oversight, research animal welfare, and biologicals under the Patriot and Bioterrorism acts, the potential for additional staff in any administrative compliance function will be hard to justify to hard-pressed senior administrators.
- A frequently unappreciated portion of compliance costs is faculty and staff time.
- Fielding an effective compliance effort is one of the major costs associated with running an ambitious institutional research program.

Introducing the Center for Economic Development, Innovation, and Commercialization: A pathway for economic sustainability from research and application to enterprise, by Ron Kessler and Pike Powers

Robert Barnhill, Vice Chancellor for Research and Technology Transfer, The University of Texas System

From the beginning, the Merrill Center conferences have brought together the university leadership from Kansas, Missouri, Iowa, and Nebraska. Many research and research policy collaborations have begun, both directly and indirectly, as a result of these meetings. Now we are ready to consider a next geographical step for research and its societal utility to encompass the Big 12 conference; the key architects of this plan are Pike Powers and Ron Kessler. Their description of this project follows:

Center for Economic Development, Innovation, and Commercialization

- The purpose of the Big 12 Center for Economic Development, Innovation, and Commercialization (CEDIC) is to develop, foster, and nurture more collaborative and mutually beneficial activities within and among the 12 universities, and to facilitate the flow of innovation, commercialization, entrepreneurship, and "know-how" from the universities to the private sector, thereby creating new jobs and enhancing the well-being of the citizens of each university's state and region.

- Intending to *accelerate economic growth and intellectual excellence through collaboration*, the Big 12 CEDIC has already created momentum and support. The 12 universities individually and their seven home states have benefited significantly from collaborating in the Big 12 Conference. This athletic success will be extended and enhanced by addressing the significant issues facing each state and university through the Big 12 CEDIC.

- Our approach involves five areas: collaboration, competition, celebration, communication, and capital. Initiatives in each of these five areas will be launched over the six months beginning on October 1, 2005.

- After meeting and developing relationships with KTEC, the Kauffman Foundation, the Kansas City Federal Reserve Bank, Department of Commerce (EDA), RUPRI, LCRA, SBC, SAIC, IBM and various Chambers of Commerce, we are ready to launch the Big 12 CEDIC.

- We have found significant interest among the private, foundation, and government sectors and from economic development entities for this innovative approach. Equally important, we have also received enthusiastic responses from Big 12 Vice Provosts for Research (VPR), Deans, and faculty members.

- We have asked the school presidents/chancellors to sign a Big 12 CEDIC Charter to acknowledge their commitment to our seven-state region and to commit the universities to addressing the regions' economic needs and collaborating on increasing research funding.

- We will collaborate outside the universities to leverage the various economic development, workforce training, and capital providers for a focused seven-state regional economic development network.

- The universities of the Big 12 have a tremendous opportunity to move beyond their past successes and to fulfill the significant role that the university plays in today's economy. By the Big 12 being the first to attempt such a collaboration and doing it well, we will set the "gold standard" for athletic conferences, economic development, innovation, and commercialization.

Research and Engagement Opportunities for Applying Science to Public Policy: The University of Nebraska Public Policy Center

Alan Tomkins, Director, University of Nebraska Public Policy Center

- In 1997, a University of Nebraska task force recommended the creation of a university-wide policy center to assist Nebraska's policymakers; in January 1998, the University's Board of Regents formally established the Public Policy Center to assist policymakers on a wide range of public policy issues.

- The University of Nebraska Public Policy Center (http://ppc.nebraska.edu/) serves the state and communities in Nebraska, as well as the nation, by providing information to policymakers that allows them to make better strategic decisions. The Center also serves a brokering function, linking policymakers with the vast expertise that exists at a large, public (and land-grant) university.

The University of Nebraska Public Policy Center in Action

- The Center has worked on a diverse issue array: Business/Economics/Taxes, Persons with Disabilities, Education, Food and Society, Governmental Administration, Natural Resources, and Rural Community and Economic Development (see http://ppc.unl.edu/program_areas/by_category.html). We currently are actively engaged in 15-20 projects; the Center employees about 40 people (about half students); and has a budget of approximately $3.0 million (approximately $175,000 from University appropriation). We are a unique policy center in that we purposively serve all three branches of government. The Governor, the Chair of the Legislature's Executive Board, and the State Court Administrator serve along with the provosts from each of the five NU campuses on the advisory board.

- Over the years, the Public Policy Center has created a bridge between the university community and policymakers.

- Simply because one scientist (or Center) advocates a position does not mean that a policymaker will necessarily follow the advice, nor should they. As the saying goes, "One scientist's gold is another's junk." A recent analysis by Dr. Ioannidis of biomedical clinical studies originally published in highly regarded medical journals between 1990-2003 and cited by others more than 1,000 times, found that nearly one third of the studies were either contradicted or modified by subsequent studies (John P. A. Ioannidis, "Contradicted and Initially Stronger Effects in Highly Cited Clinical Research," Journal of the American Medical Association, 294:218-228 [2005]). It is important to be prepared to help a policymaker deal with the fact of changing scientific evidence. Scientific information is nonetheless a highly valuable tool to shape policy. Academia has a special role to play in ensuring that quality scientific information is presented understandably and effectively to policymakers.

- There have been several instances in which the Public Policy Center has had an impact on policy decisions in the state of Nebraska. The full text details the PPC making a difference in: child support payments & disbursements; inequities in the justice system for minorities; behavioral health; and water resources.

Public Policy and the Scientific Agenda: Is there a place for Social Science?

Mary Lee Hummert, Associate Vice Provost for Research, The University of Kansas

- Federal funding for basic research in the behavioral and social sciences (BSS) lags significantly behind funding for research in the natural, physical, and medical sciences. The 2004 Report of the Working Group of the NIH Advisory Committee to the Director on Research Opportunities in the Basic Behavioral and Social Sciences (http://obssr.od.nih.gov/activities/Basic%20Beh%20Report_complete.pdf) reports that total federal research spending 1993-2003 has been consistently lower in behavioral and social science fields than in life sciences, physical sciences, mathematics and computer sciences, and engineering fields.

- Administrative restructuring and a change in policy at the National Institute of Mental Health also promise to have negative effects on basic BSS research. NIMH was one of the institutes that provided a home for basic BSS research, with 8.1% of its funding awarded to basic BSS research in 2003. However, in October 2004, NIMH Director Thomas Insel announced an increased emphasis on translational research and a decreased emphasis on basic research, especially in the social sciences (*Science*, 22 October 2004).

- Clearly, public policy as set by those within the National Institutes of Health in particular, and the federal government in general, has an influence on future progress in basic BSS research.

- Why should we care about the challenges to funding basic BSS research? Because the insights gained from such research are essential to a full understanding of the scientific challenges we face today.

- Basic BSS research is a necessary precursor to translational research and an important partner in many investigations of interest to the medical, natural, and physical sciences. Similar arguments, however, were advanced in the Report of the Working Group of the NIH Advisory Committee to the Director on Research Opportunities in the Basic Behavioral and Social Sciences (http://obssr.od.nih.gov/activities/Basic%20Beh%20Report_complete.pdf).

- As research administrators, we are concerned with promoting funding opportunities for basic researchers in all disciplines, including the behavioral and social sciences. Therefore we must consider ways that we can help our basic BSS researchers to be successful in this funding climate.

- Lending our support to recommendations such as those from the NIH Advisory Committee is helpful, but we can offer more immediate, direct benefits to behavioral and social science researchers on our campuses by: building interdisciplinary research

programs; developing faculty mentoring programs targeted at BSS researchers; and ensuring that basic BSS research is included in materials featuring campus research.

- Ensuring that reports of university research successes include examples of funded basic BSS research will communicate to students and faculty that basic research in the behavioral and social sciences is valuable and valued. Communicating this message is critical to maintaining the morale of basic BSS researchers and providing an incentive for adding to BSS successes in the future. Second, it will help to broaden external audiences' conceptions of "research" and "science" beyond the natural, physical, and medical sciences.

- The data show that basic BSS research faces funding challenges, even though evidence of its importance to a full understanding of the scientific challenges of the 21st century is abundant. Advocating for policy change within funding agencies and adopting the three strategies outlined above would improve the research climate for those in all disciplines. References list, p. 67.

When Science and Politics Collide

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

- As a physician, an educator, a researcher and a leader in the health care community, I believe it is the responsibility of all scientists and educators to be a resource, both to the public and to lawmakers who have a responsibility to decide crucial issues such as stem cell research and therapeutic cloning. For that reason, I have testified before the Kansas House Federal and State Affairs Committee against House Bill 2355, conducted a series of Stem Cell Research 101 seminars with Kansas legislators, and given 50 talks on the science of stem cell research to citizens throughout the state of Kansas.

- The critical problem that I see with HB 2355 is that, while it aims to outlaw human cloning, the specific language of the bill does so at the expense of criminalizing the exploration of an entire category of research that holds the potential to profoundly ease human suffering—research that will allow us to study the molecular basis of diseases as they develop from conception to death. This research holds the promise of discovering treatments and cures for such chronic diseases as Parkinson's, juvenile diabetes, ALS, heart disease, cancer, spinal cord injuries and Alzheimer's disease.

- Much of the controversy and misunderstanding about stem cell research centers on use of the emotional and highly-charged word "cloning." When most of us hear this word out of context, we tend to think of the process of creating genetically identical human beings–-human reproductive cloning–-a terrifying prospect to be sure. In fact, there is another type of cloning; "therapeutic cloning" seeks to create a line of stem cells genetically identical to the originating cell for use in research and treatment.

- One of the most promising forms of therapeutic cloning is "somatic cell nuclear transfer" or SCNT. This is the transplanting of a patient's DNA into an unfertilized egg in order to grow stem cells that could replace organs or tissue in order to cure diseases. They could also be used to discover new drugs for the treatment of patients.

- SCNT is not meant to create new life; it literally extends life. SCNT works with the cells of an already-living person to create an environment where these cells can multiply to produce stem cells. These stem cells can then replace damaged cells in the body. SCNT is also essential to help scientists understand how stem cells and other cells develop. This includes understanding how cancer cells grown and develop, which is essential for ultimately finding a cure for cancer.

- The goal of therapeutic cloning or SCNT is not to produce babies, but to produce cells. There is no fertilization of the egg by sperm, no implantation in the uterus and no pregnancy.

- SCNT's aim is to treat or cure patients by creating tailor-made, genetically identical stem cells that the patient's body will not reject after transplantation. SCNT could allow patients to be cured using their own DNA and could result in significant breakthroughs just as the use of stem cells in bone marrow transplants is saving lives today. Unfortunately, SCNT could be criminalized under the provisions of HB 2355.

- At The University of Kansas Medical Center, we are supportive of efforts to utilize adult stem cells–-stem cells drawn from fetal cord blood or from other adult issue sources—for biomedical research. However, adult stem cells and early stem cells are not replacements for one another. Because early stem cells are pluripotent – meaning they can become any cell in the body—they can be applied to a far greater variety of contexts than adult stem cells and can also be grown in a lab indefinitely. Consequently, we believe that pursuing both avenues provides the best hope for achieving dramatic progress in discovering new cures.

- Another unintended consequence to criminalizing SCNT could be that patients and physicians may leave our medical centers and hospital to pursue the possibility of more innovative care provided in other states. If that occurs, there will be a direct economic impact and an indirect loss of additional business growth.

- WSJ/Harris Interactive Poll, June 2005:
    - 74% of Americans think that stem cell research should be allowed
    - 14% believe it should not be allowed
    - 12% are not sure

  According to similar polls conducted in Kansas and Missouri, 61% of Kansans and 56% of Missourians approve stem cell research; 21% and 24%, respectively, disapprove. When asked if they approve or disapprove of SCNT research, 71% of Kansans and Missourian said they approved.

- Anti-stem cell or human cloning bills introduced this year in the legislatures of Missouri and Kansas but that were not passed into law are likely to be reintroduced in 2006.

- In response to restrictions on stem cell research, many Americans have become involved in advocating *for* research. We have a group of committed individuals in the Greater Kansas City Chamber of Commerce who has made this its top legislative agenda item. A campaign by the Kansas Coalition for Life Saving Cures will encourage many Kansans to advocate for research to improve the quality of life for those suffering from debilitating disease. It is our

opportunity to teach new audiences, to build new coalitions and to advance our mission of improving human health through research.

- I applaud efforts to outlaw human reproductive cloning, as do all reputable researchers, but I urge our lawmakers to advance the cause of research, education and healthcare by opposing legislation that limits the life-saving cures and treatments central to our shared mission and the overall quality of life of Kansans.

Scales of Engagement, Challenges, and Opportunities in Linking Public Policy and Research

Duane Nellis, Provost, Kansas State University

- Global and national level policies and agendas at times drive priority research thrusts; yet state and local policy decision-makers and incentives, as well as the public at large, can strongly influence university research agendas and strategies and must not be minimized. Often, strategies that are sensitive to maximizing research potentials between global, national, state, and local policies and attitudes have the greatest potential to advance university research success and create sustainable development opportunities.

The Global and National Scale

- As Alan Leshner has pointed out (2003), science is an integral part of everyone's lives: "every major issue facing our global society today has science and technology components at its core." The international and national levels of policy response to these core issues have created research challenges and opportunities as scientists attempt to address these substantial research questions.

- The resulting challenges and opportunities for the research university can be influenced by public perception and attitudes toward a particular science issue, as well as by international or national policies that restrict research agendas. At various times, scientist efforts to "enlighten" the public have only further divided the public on certain sensitive issues. International and federal policies in response to long-term global change create other challenges for the research university.

- Global climate change, post-9/11 federal policies related to immigration, debates around renewal of the Higher Education Act, and strategic priorities related to major federal agencies will continue to have ongoing impact on university graduate programs and research. The reauthorization of the Higher Education Policy Act now being debated could further increase federal performance expectations of universities receiving federal funding. Federal agency funding priorities are also changing as new strategic security research thrusts gain higher levels of congressional support.

National Policy Debates, State and Local Level Adjustments, and Kansas State University

- At the federal level, only limited forms of stem cell research have access to federal research funds, and Kansas and other states have threatened to further regulate stem cell research and any link to cloning. A team of K-State scientists in partnership with a University of Kansas researcher has done research on umbilical cord matrix stem cells, which are readily available and less controversial than stem cells linked to somatic cell nuclear transplantation. Efforts are underway at K-State to establish a center for such stem cell research. Uni-

versity researchers are also working in issues surrounding genetically modified crops and BSE—bovine spongiform encephalopathy.

Kansas Senate Bill 345, Performance Agreements, and Kansas State University Research

- Coupled with passage of Kansas Senate Bill 345 in 1999 and some restructuring of Kansas Higher Education was a movement toward block grants for Kansas regents universities, tuition retention, evolving performance agreements from the Kansas Board of Regents, and incentives for looking anew at revenue sources and creative approaches to sustain and, where possible, enhance university success. At Kansas State University, state level funding as a proportion of our total appropriation has dropped from over 40 percent ten years ago to approximately 27 percent in the most recently completed fiscal year. In response to this trend and Senate Bill 345 K-State has been working to identify alternative financial resource areas, including creative ways to advance K-State's position as a premier land grant institution while enhancing our success in competitive extramural funding.

- The institution's recently created Targeted Excellence program has a strong focus on interdisciplinary, integrative collaborations geared to exploiting and developing institutional strengths, with overarching national and global concerns for security and resource sustainability as factors of influence, collaborations, and emphases. Details of the program and examples of successfully funded projects are found in the full text.

- We are exploring ways to extend our Targeted Excellence and related research initiatives through: (1) enhanced community-state partnerships, (2) enhanced links to the National Institute for Strategic Technology Acquisition and Commercialization (NISTAC), and (3) capitalizing on opportunities presented through the Kansas Bioscience Authority and related partnering with The University of Kansas and K.U. Medical Center

Conclusion: This is a period of significant transition as universities respond to changing public policy at various scales of influence that extend from local to state to national levels and beyond. Our future success will be determined by how well we engage the public at all scales of operation as well as how effectively we create new approaches to enhance revenue streams to our university research enterprise within new public policy environments. In the public policy arena we need to:

- use citizen groups to engage local communities and the public on the value of science;
- train more journalists who can communicate the scientific basis of and opportunities resulting from scientific discovery;
- have a more coordinated effort at all levels to popularize science;
- better articulate the impact of science on the quality of our lives, and
- better understand the impact of scale and relationships in modes of operation from local to state to national.
- Simultaneously, we need to explore creative alternative revenue sources through new partnerships and ideas that allow research universities to continue to thrive as beacons of research discovery and engines for economic development.

References list, p. 77.

The Science and Public Policy Interface: Subset of a Larger Problem

David Shulenburger, Provost, The University of Kansas

- A major source of the current stress on higher education in the United States, particularly public higher education, is the decision made implicitly in the legislative halls of every state that higher education is primarily a private good, not a public one. At least since the passage of the Morrill Act in 1862, the notion that higher education serves public ends has been widely accepted; but during the last thirty years, legislative opinion, as evidenced by legislative appropriations, has changed. We now appear to believe that higher education has such a private goods nature that it should be paid for primarily by those who receive it, the students, and to a smaller degree, by the public, which apparently is deemed to be only a minor beneficiary.

- Since the cost of providing higher education has increased while the public support has decreased, students, private donors, corporate donors, research foundations, etc., have become the new financers of higher education. As additional monies have come from these sources, so have additional demands and influences. Many of these demands have come from the U.S. government in the form of restrictions on the foci of research, but the U.S. government is hardly the only donor making demands on the academy.

- State legislatures have not appropriated funds to higher education proportional to the growth in personal income. In 1977, 8.5% of personal income was appropriated to support higher education. By 2003, this amount had fallen to under 7%. The decline in expenditure relative to total state expenditure shows the same trend.

- Public universities have responded by increasing tuition. Tuition as a proportion of funding grew from just over 13% of budgets in 1977 to over 18% in 1997. The state-funded portions of university budgets comprise less than 25% of the total.

- Private universities had no state support to lose. To compensate, they instituted tuition levels several times higher than their public counterparts and vigorously sought private endowments. Except for the occasional reversal in endowment levels caused by market fluctuations, this combination of endowment earnings and high tuition has given private universities a funding edge.

- The biggest portion of any educational institution's budget is for faculty salaries. Due to the lower level of tuition and relatively smaller state appropriation, salaries at public institutions have declined relative to salaries at private ones. In 1977, full professor salaries at public institutions were close to parity with those at privates; salaries of assistant professors were slightly greater and associate professors were paid exactly on par. By 1997, professors' pay at public institutions was at 82% of private peers, associate professors were at 88% and assistant professors were at 84%. Those differences are enough to cause those who are mobile to relocate and to lower morale for those who are not able to move. Unfortunately, the reduction in relative salaries was accompanied by increases in teaching loads.

- Over 20 years this differentiation in resources was accompanied by increased differentiation in the quality of entering students at public and private universities. On both verbal and math SAT scores, the private institutions widened their advantage over their public

brethren. Student quality statistics are complemented by the perceptions of tenured faculty: Substantially more public than private faculty felt undergraduate education had declined in quality at their institutions.

- The tuition increases that have been so much in the headlines are a defensive measure designed to keep the relative decline in the quality of public universities from growing worse. The stakes are high. The competitiveness of our country in science and industry may well rest in the balance.

- When public institutions' historic patrons--state governments--withdraw support, those institutions either must reduce their budgets or find other funding. The former choice has severe, negative quality implications that are illustrated clearly by the previous data. The competition to public universities comes from private institutions. The decline in available funding per student already has had the apparent effect of relative quality reduction. In my judgment, the nation will be poorly served if we permit public higher education to fall further behind in quality relative to the private sector.

Sources from which additional funding is being sought:

- Tuition
- Federal grants
- Athletics
- Sale of intellectual property
- Private giving
- Exclusive commercial rights and sponsorships

- Donors, sponsors, vendors, etc., generally want something for the money they contribute. Examples are given in the full text of what various subsets of fundors want in return for their financial support, including the constraints to research that result from a growing dependence on federal sources for funding. Similar demands made by students, athletics, and other funding sources are discussed, as is the increasing intrusion of the commercial world into the academy.

- The clever university bureaucrat can dance to the various donors' tunes without being unfaithful to the university's mission. But does this process have unwanted consequences? At a minimum, valuable administrative time is spent doing all the permutations needed to satisfy donor demands. More menacing is that this process of accommodation corrodes trust.

- Rather than using our brains to outwit those whose resources and power might enable them to restrict university activities, it would be far better to persuade them of the long-term good done by letting free inquiry characterize the academy. The larger society has been well served by academic freedom and this truth is evident all around us.

- We must integrate the academic mission into society and be accountable to the broader community or risk losing the support necessary to succeed. The pressure to bend the long-term mission of the academy to the short-term desires of individuals is pernicious and will serve no one well in the long-term. Let us work for understanding to redirect these pressures to the long-term good of the academy and society.

The Current Context for Science, Society and Public Policy

Alan I. Leshner, Ph.D.[1]
Chief Executive Officer
American Association for the Advancement of Science
Executive Publisher, *Science*

As with all human activities, science is not conducted in a vacuum, and the way its products are used is determined to a large degree by the broader societal context in which the scientific enterprise is imbedded. That context is determined by three major factors: issues arising within science itself; government regulations, priorities and funding patterns; and the broader and changing relationship between science and the public.

Major trends within science

Advances in science are coming at an ever-accelerating pace, in part because of major changes occurring in the way the scientific enterprise is organized and operates. For example, so-called "big science" team research was historically only a characteristic of a subset of the physical sciences, where people have to work together and share resources on projects such as those involving accelerators or telescopes. Conversely, the life sciences operated only in the "individual investigator" mode: A laboratory director might have a few graduate students and post-doctoral associates, but each established scientist fundamentally functioned as his or her own enterprise. The advent of the Human Genome Project (HGP), however, marked a major shift for the life sciences. Completing the HGP required team work on an unprecedented large scale. We now are seeing more and more team projects like those in proteomics or in sequencing the genomes of other species.

A second major trend affecting the way science is organized and carried out is the increasing multi-disciplinarity of many of the most interesting and challenging scientific questions. For example, getting answers to virtually all of the 125 great, unanswered questions identified recently in the journal *Science*[2] (the list begins with "What is the Universe made of?") will require that scientists work across traditional disciplines. In fact, many people believe we are beginning to see the demise of traditional disciplinary research and of

1. Mailing address: AAAS, 1200 New York Ave., NW, Washington, DC 20005; aleshner@aaas.org

2. 125 Questions: What Don't We Know? *Science*, 2005: Vol. 309, 1-204.

disciplines themselves. This will become highly problematic if we continue to try to maintain our traditional disciplinary departmental structures in universities and funding agencies.

The third major trend within science is that rapid advances in technology are now enabling entirely new kinds of questions to be asked. Many of us were taught originally that the normal sequence of events is that scientific advances lead to new technologies, which then lead to applications. We now are seeing that technology is driving science as much or more than the reverse. Examples are easy to find. Those in my own fields include how brain imaging techniques are enabling us for the first time to look into the brains of living, awake, behaving human beings and observe their minds in neurobiological action. This ability is revolutionizing the ways we can study mind-body relationships. It also is revolutionizing our fundamental understanding of the processes underlying such important human characteristics as mental disorders and addiction.

New technologies are also expanding how we view the processes of research. Most of us were taught that we begin any scientific investigations with a clear hypothesis, which we then test systematically. In fact, it has long been very difficult to get a grant without a clear hypothesis stated right in the beginning of the proposal.

But now, new technologies, like gene arrays, are enabling us to collect large amounts of descriptive information that we will only know how to interpret after the data are analyzed. This kind of an approach—and gene arrays in particular—has been extremely important in understanding which biological systems are worth investigating further in a variety of complex areas, again including addiction and mental disorders. The grant review process, however, has been slow to catch up with the trend, and it still is very difficult to get funded for these kinds of studies.

Trends in government regulations, priorities and funding

The events of September 11, 2001, resulted in major changes in both the context and priorities for American science. The most visible impact was the dramatic set of changes related to international travel—primarily for non-US citizens coming into the United States, but also for Americans going abroad. New, complicated visa processes put in place after 9/11 have caused dramatic reductions in the numbers of foreign graduate students and scientists both able to attend conferences in the United States and joining the American scientific student and work forces. Table 1 shows the results of a Council of Graduate Schools Survey, and illustrates the dramatic reductions in international graduate applications post 9/11.[3]

The events of 9/11 were also followed by a dramatic shift in national research priorities toward issues related to individual and national security. Wholly new research emphases appeared and received tremendous amounts of Federal government support. These included bioterrorism, transportation security, cybersecurity, and safety of the

3. Brown, H.A. and Syverson, P.D. Findings from U.S. graduate schools on international graduate students admission trends. Council of Graduate Schools, September 2004.

food supply—all areas that had received little or no government attention before. This shift in priorities was also reflected, of course, in much smaller increases in funding being provided for more traditional areas of research. A full description of these trends over the past few years in Federal funding can easily be found at: http://www.aaas.org/spp/rd/.

Table 1: Trends in International Graduate Applications, 2003-2004 and 2004-2005

	Application Change 2003-2004	Application Change 2004-2005
U.S. Domestic and Permanent Resident	0%	- 1%
International	- 28%	- 5%
Country of Origin		
China	- 45%	- 13%
India	- 28%	- 9%
Korea	- 14%	0%
Middle East	+ 4%	+ 6%
Field of Study		
Business	- 24%	- 8%
Education	- 21%	- 3%
Engineering	- 36%	- 7%
Humanities	- 17%	+ 2%
Life Sciences	- 24%	- 1%
Physical Sciences	- 22%	- 3%
Social Sciences	- 20%	- 4%

The changing relationship of science and society

A vibrant science and technology (S&T) enterprise is central to the success of every developed country, since most productivity and new product gains are traceable at least indirectly to advances in S&T. Moreover, those countries lacking strong scientific infrastructure appear doomed to lag behind their counterparts with strong science. By now, science and technology are imbedded in virtually every aspect of modern life, and thriving in that environment requires that individuals have reasonable comfort and knowledge about S&T and their products.

The relationship between science and American society has traditionally been a good one; a large majority of the citizenry recognizes that the benefits of scientific research far outweigh its risks. In fact, the percentage of Americans who see S&T as fundamentally positive has remained above 70% since at least the mid-1970s.[4] This contrasts with the European Union, where there have been significant declines in public appreciation of science over the past decade or more.

This optimistic view of U.S. attitudes toward science is somewhat overstated, since at the same time that Americans seem to value science, they do not really understand what is and is not science. For example, 60% believe in extrasensory perception; 41% think astrology is somewhat scientific; 47% do not answer "true" to the statement "Human beings developed from earlier species of animals."[5]

Although the overall relationship remains positive, many are reporting that aspects of the science-society relationship are deteriorating. There appears to be a significant increase in the politicalization of science and its findings, and overall

4. Data on the American public's understanding and views of science and technology have been extensively reported in the National Science Board's biennial Science and Engineering Indicators. Attitudes in the European Union have been reported in the European Commission's Eurobarometer 2005 report.

5. National Science Board, Science and Engineering Indicators, 2004.

confidence in science appears to be eroding.

A major contributor to this recent trend is the addition of a new dimension in the relationship between science and society. Whereas historically, S&T have been evaluated primarily on the basis of their relative costs and benefits, we now are seeing S&T evaluated in terms of the way their products relate to core human values as well. A well-known example of values considerations being overlaid onto the scientific agenda is the domain of embryonic stem cell research. People's positions on the acceptability of this line of research are heavily influenced by their views of when life begins—at conception, embryo implantation, birth. A second example was provided by a recent attempt by some members of the U.S. House of Representatives to de-fund four NIH grants whose focus on sexual behavior made those members of Congress uncomfortable.[6]

A dramatic example is the attempts to insert the teaching of creationism or "intelligent design" (ID) into the science curriculum as a purported scientific alternative to evolution. ID advocates argue that although humans may have developed from lower organisms gradually over billions of years, that process had to have been guided by a supernatural force, an "intelligent designer," since they cannot conceive of complex organisms and biological systems developing through random mutation and environmental adaptation. They label ID a scientific alternative to evolution and claim therefore that it should be taught as a controversy in science classrooms. This not only would introduce a fundamentally religious concept into the science curriculum, but would pit religion and science against each other.

The core problem is that intelligent design is neither a science-based nor a scientifically testable concept. The accepted methods of science—direct observation, experimentation, systematic measurement, replication—cannot be applied to the question of whether there is or was an intelligent designer. Moreover, scientific explanations are limited to the natural world. Therefore, we in the scientific community object to any reference to ID as being scientific. We cannot allow people to redefine science for their convenience or to fit their ideologies. Moreover, we do not want to lead young people astray by teaching them non-scientific facts and theories as if they were scientific.[7]

The primary consequence of this new overlay of values onto science is substantially increased tension between science and segments of society. That tension is being expressed in a variety of ways, including increased attempts by the public and policymakers to shape or modify the research agenda. Whereas we traditionally think of science and technology as having influenced the course of civilization and the overall status of society, we now are seeing more and more attempts by the public to influence the course of science. Members of the public want to help frame the research agenda, including at times

6. A transcript of the Congressional floor debate on this issue is available at http://www.apa.org/ppo/issues/nihtoomeydebate.html.

7. Leshner, A.I. Redefining science. *Science* 2005: 309, 221.

deciding what can and cannot be studied.

This values-related tension, when combined with some other factors, is creating a widening divide between science and society.[8] Those other factors include a misunderstanding about the meaning to scientists of the word "theory," which is different from the popular view that a theory is simply an educated guess. This becomes an issue when, for example, the intelligent design advocates claim it to be a "theory" just like the theory of evolution. Of course, evolution is supported by thousands of observations and studies and certainly is substantially different from an educated guess or a belief per se, as is intelligent design.

Another major contributing factor is the assumption by scientists that scientific illiteracy on the part of the public is the central cause of the tension, and that the problems can be solved simply by educating the public better. The problem, however, is not just lack of understanding. Often, the public does understand the science, and they just do not like what it is showing or what it means. The case of embryonic stem cell research is an excellent case in point. Here there is genuine disagreement about when life begins, and stem cell opponents—many of whom understand well the nuances of embryos, blastocysts, implantation and other scientific concepts—simply do not agree that any embryos should be sacrificed for the sake of any research.

8. Yankelovich, D. Winning greater influence for science. *Issues in Science and Technology*, Summer 2003.

Bridging the divide—from public understanding to public engagement

How can we reduce the tension in the science-society relationship and forestall any further deterioration? Our approach so far has been primarily to rise up in protest any time the integrity of science and its products is threatened, and I do believe we need to continue to do that. We cannot allow anyone to redefine science or to misinterpret scientific findings for their convenience. The scientific enterprise needs to be the principal guardian of the scientific method, including insisting on peer review before publication/publicity and conveying the appropriate caveats as findings are discussed publicly.

Simply protesting violations of our norms will not do it alone. In the same way that we cannot simply educate our way out of these dilemmas, neither can we lament our way out. I believe the only way to move forward is to engage in a much more open and genuine dialogue with the public about science in general and about specific scientific findings in particular. We need to move from what might be thought of as a public understanding model into a true public engagement model.

We need to move from what many have experienced as a paternalistic monologue by the scientific community directed at the public, into a true multi-directional dialogue that involves listening as well as speaking. We need to hear from the public about their concerns about science and technology—how they see the risks and benefits, and how they experience the encroachment of science onto human values. We need to listen to the public's priorities among research

areas, and we need to hear the questions the public would like us to answer so they can make more informed decisions. In short, we need to allow the public to help shape the research agenda. By this, I do not mean to list areas that are permissible to study and those that are not. I do mean that the public should be allowed to pose questions for science, and that we need to respond.

Does the public want to be engaged in this way? No systematic surveys have been conducted in the United States, but we know that many people do read the science news in their local newspapers, and more general attitude surveys do show high levels of interest in science.

A relevant survey of the public's interest in greater engagement with science was conducted in the United Kingdom and reported in March 2005.[9] Results included the findings that:

- 74% of people say they ought to hear about potential new areas of science and technology before they happen;
- 81% say the public should be consulted on decisions about scientific developments;
- 51% would be interested in taking part in a national debate on science-related issues;
- 79% say that scientists should spend more time discussing the implications of their work in public;
- 75% think scientists should listen more to what ordinary people think.

What to do? How should we go about engaging with the public? Ruth Wooden, President of Public Agenda, a non-profit organization that specializes in engaging with the public on a wide variety of societal issues, advises against some of our traditional approaches.[10] She suggests it is actually counter-productive to simply hold a series of public education events where scientists pontificate in jargon-laden terms to "educate" the public. She also advises against large town meeting types of forums, where the extremists on both sides of the issue dominate the conversation but never reach any common ground. Public Agenda advocates small group formats, where the groups are asked to work through specific questions and options for resolving issues, looking for areas of common ground.

Some groups are working in this mode already. Many of the projects supported by the National Human Genome Research Institute's program on Ethical, Legal and Social Implications (ELSI) use small group engagement approaches. AAAS's Dialogue on Science, Ethics and Religion brings together scientists, ethicists and religious leaders to discuss issues of common concern. A third example is the Genetics and Public Policy Center at Johns Hopkins University, which considers issues at the interface of genetic research and public interest/concern.

AAAS is in the process of developing a new programmatic center whose focus will be public engagement with science and technology. The notion is to use a combination of approaches both to engage the public and to defend the integrity of science and the use of its products.

9. Office of Science and Technology, UK Department of Trade and Industry, *Science in Society*, March 2005.

10. Wooden, R. Remarks during the annual meeting of Research! America, 2004.

Concluding comments

As I look at the evolving relationship between science and society, I am reminded of that ancient curse "May you live in interesting times!" The science has never been better, and our enterprise has never been stronger. On the other hand, the science-society relationship is more tense than ever in my professional life. From a historical perspective, the strain we now are experiencing may not really be new. The tension level between science and society has increased many times in the past, typically when scientific findings abut against values questions like the essence of our humanity, our place in the universe, or when life begins, or when scientific findings conflict with political expediencies.

Whether we are experiencing a new trend or a recurrent cycle, the science-society relationship is in great need of attention. And we will need to adopt a new strategy to repair it. We will not be able to simply educate our way out of the problem, because its essence is not simply lack of public understanding. As mentioned before, many people do understand what the science is showing; they just do not like it. Moreover, in contrast to scientists, most people in the community do not feel bound to stick to what the science is showing.

I believe the only viable approach as we move forward is to do a much better job of engaging the public, in true dialogue about their concerns and how they might be addressed. I am not so naïve as to suggest that we try to convert the ideologues on either side of controversial issues. But the majority of people are not ideologues, and we should be able to find meaningful common ground that will allow science to do its best at its principal task—advancing society and improving the human condition.

Classified Research and the Open University

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Not long ago, I—and others—spent more time than I wanted reviewing a proposal from a new faculty member that was clearly in violation of The University of Kansas classified research policy. The name of the proposal was "The KILL Missile System." The title alone raised a red flag, because KU has a prohibition on conducting research with intended results that could destroy or incapacitate human life.

We at KU have been talking about our classified research policy for some time, as I think colleagues at many institutions are, and faculty governance is considering a revised policy. We have looked at other universities' classified research policies, and I have to admit that KU's current policy may be the most convoluted of them all. There is a history behind that, as I am sure there is on most campuses. But there must be a way to find a simple, non-convoluted way of dealing with this issue.

In this paper, I discuss the term "classified research." To do so, I relate the discussion to the overdone practice of simplifying an issue by collapsing a number of complex questions into a single black-and-white question. I also want to comment on what some other universities are doing regarding classified research and then propose a simplified classified research policy that addresses the major issues of concern in conducting university research today.

Framing the questions

It is always good to look back to the nation's founders for wisdom. I am struck by something Thomas Jefferson wrote in 1820 about the founding of the University of Virginia: "This institution will be based on the illimitable freedom of the human mind. For here we are not afraid to follow truth wherever it may lead, or to tolerate any error so long as reason is left free to combat it."[1]

With that as an institutional research policy, what would Jefferson have to say today about the University of Virginia, for example, conducting classified research? What might Jefferson say about the whole notion of classification? Scientists including Edward Teller were opposed to classification. While we could have a philosophical debate about the practice of classification, that is not the discussion here. In this paper we are taking as a given that there is information

1. Letter to Thomas Jefferson to William Roscoe, 27 December 1820. L&B 15.303

to which the federal government or non-governmental organizations restrict and control access. So this is not about classification per se but rather dealing with it as it exists.

In attempting to frame the question and develop a policy, one is hindered by a problem that clouds the issue: the collapsing of a complex set of questions into a single question to be answered "yes" or "no." Take global warming as an example. This issue has become so politicized that every aspect of the set of questions related to global warming has been collapsed into one question with an answer that is almost in the realm of belief or non-belief. In fact, there are many questions: by how much is the climate actually warming, whether it is short-term or long-term, what are the causes and the cures, etc. But today you are either for global warming or against it, period.

In the same way, while the topic of classified research embraces multiple questions, classified research policies often reflect this collapsing of the issue. What is needed is to deal with classified research as a single question, in the true sense of the word, and then tease out the other questions contained in the term.

Classified research issues

My insight into this issue is rooted in the 20 years of my career spent working on national security projects in places that required a high-level security clearance. Classified research presents several thorny issues for universities:

- Philosophical opinions
- Publication restrictions
- Practicality and cost
- Academic freedom
- Harm to students' educational progress

Philosophically, we have the following questions:

- Should an institution engage in research when some or all of the research material/results cannot be released to the general public?
- Should a university directly support the military/industrial complex, conduct embryonic stem cell research, etc?
- Should some faculty and students have access to information that others cannot know?

Some are concerned about having research material that cannot be released to the public. Some are concerned about supporting the military/industrial complex. Note that the current KU policy contains a very specific reference that prohibits research that "might involve, for example, the mining of an enemy harbor or the mapping of guerilla locations in a country that is involved in civil war."[2] This language was clearly a reflection of the Vietnam conflict and the time in which the policy was written. But some people also object to conducting embryonic stem cell research. Some are opposed to research using laboratory animals. There may be opposition from some to almost any area of research that one might undertake.

As to restrictions on publication, the Association of American Universities takes the position that member

2. Statement on Classified Research, from The Handbook for Faculty and Unclassified Staff, 17 February 1986. http://www.research.ku.edu/kucr/policy/comp/class.shtml

institutions should not accept unlimited scope or time publication restrictions. Most institutions accept this in principle but allow exceptions.

Note that this position does *not* refer to classified material per se. It is a mistake to assume they are one and the same. It is a mistake to assume that classified means restricted publication in all cases; it is a mistake to assume that unclassified research means unrestricted publication. While there is an automatic assumption that classified material always impedes the ability to publish, I will tell you from my own experience that is not always true. So we have to sort out the real issues to deal with each question. This is the problem with collapsing many questions into one.

Now let us turn to practical matters. What does it mean if someone says, "I want to do classified research?" Does it mean we have to have a security force? Will we need a building with barbed wire around it and 21-year-olds with Uzis standing guard? What other costs are there? Of course there is the question of who pays. And if one ventures into the realm of classified research, there is yet another set of rules from Washington with which to deal.

Other issues involve academic freedom, and the matter of segregating students and faculty into "cleared" and "un-cleared" categories. And there is a serious problem, classified material or not, when we do things that harm a student's progress toward a degree.

So what is classified research?

In the sense of what "classified" really means, we deal with "classified research" every day at our institutions. An example is private health information. We conduct human subject research where we release general results of the study, but not the details about the participants. Even if someone's specific condition is very interesting, we do not put her name and/or symptoms in a published paper unless she approves. And even then we might not.

There are many things we do not publish. We generalize results, but many other things we keep quiet. We deal with company private material, and that is classified. With survey data, we ask questions of school children but do not release data about specific students. Colleagues cannot read my KU conflict-of-interest declaration, nor I theirs.

So how is national security classified information—secret, top secret and above—different? The answer is that it really is not. It simply represents data that cannot be released. Other than the specific sets of rules and the subject matter, a person's answer to a survey question or the wingspan of an advanced military airplane are both restricted, meaning classified per se. The data cannot be released to the public without someone else's approval; to handle the information differently results in trouble.

So what is different? Why does classified research require so much discussion and so many policies? To answer that, we have to break out the real questions that we want to ask. For example, Should the university accept a contract or grant with an unlimited delay of publication? In other words, you may never get to publish without the approval of the sponsor. At KU, we can accept delays up to a certain period of time, but we simply do not accept a grant or

contract that has an unlimited delay. But that is a different question than whether or not we do research that involves national security.

Other institutions

What is everyone else doing? Staff in my office did a random check of the published policies of institutions similar to KU but not represented at this conference. (I avoided them because I did not want to engage in a conversation that begins, "Well, our policy doesn't really mean that." That is not the point of the review, since there are always many nuances in practice with all such published policies.) This chart depicts what we found.

University Classified Research Policies

	Chicago	CAL	Oregon	MIT	GWU	KU (current)	KU (proposed)	Virginia	Michigan	Florida	ASU	UT-Austin	UNC	CU	MD
Outright ban	•	•	•												
Strong opposition, tantamount to outright ban in practice?				•	•	•	•	•							
Approval process for exceptions				•	•	•	•	•	•	•	•	•	•	•	•
"Public Interest" a factor?				•	•	•	•	•	•		•	•	•		•
Off-campus?				•			•	•						•	•
National labs?	•	•		•											
Classified theses/ dissertations prohibited?				•	•	•	•	•			•		•	•	•
Secured campus facilities prohibited?	•	•			•			•							•
Ban on specific subject matter?						•	•								

The first three institutions listed—University of Chicago, University of California at Berkeley, and University of Oregon—have outright bans on conducting classified research. But both Chicago and Berkeley also say it is okay if you do the research in a national laboratory rather than on campus. We did not include MIT in the group with an "outright ban" even though they state publicly there is one. That is because MIT also says it is permissible to conduct classified research at Lincoln Laboratories. Thus some of these outright bans have an escape valve.

The second row identifies institutions where there is a strong opposition to classified research but not a ban. Some "We don't allow it, except …" policies are much stronger than others—almost requiring the declaration of a national emergency. I list KU twice, because we have a current policy and a proposed policy. (Depending on how the lawyers read the proposed policy, it may move KU into the first row, since the

intent of the authors is an outright ban on classified research.)

When exceptions are allowed, each institution sets out a process. Most of them cite the national interest or public interest as a reason for engaging in classified research. Some of them say it is permissible to conduct classified research if it is performed off-campus. In fact, the new KU policy says that.

Many of the policies prohibit classified theses and dissertations. It might seem unnecessary to state such a ban, but I have seen and read theses with "top secret" stamped on them, so, again based on my past experience, it is occurring.

Some policies expressly prohibit having a secured facility on campus. Of course a "secured facility" can range from a locked safe to the fenced-in building with the guards with guns. While the latter certainly seems inconsistent with at least my vision of a college campus, a locked safe may not be.

Only one institution in this sample actually banned a particular subject matter, and that institution is KU. We have gone from banning research concerning the mining of Haiphong Harbor in the old policy to banning the intentional harming of humans in the new. Frankly, I think the new proposed policy raises serious questions about stem cell and abortion research, for example. I am disturbed by the possibility of activist groups and others contending that we are violating our own research policy by conducting certain lawful experiments—and they may be right.

A proposal

I propose a Conduct of Research Policy to replace a Classified Research Policy. In a return to the Jeffersonian ideal, I propose that institutions ought to have a simple statement about academic freedom and research:

Principle I: Free and open inquiry

The proposed KU policy and this murky issue of subject matter restriction is a real problem. With the "KILL Missile System" proposal, the staff was ready to reject the proposal out of hand not because the faculty member violated the classified research issue, but due to the subject matter issue. In the end, the faculty member's proposal concerned fundamental aerodynamic research, but the wording he initially used was problematic.

This is not the way for a research university to go. Yes, we should obey all federal, state, and local laws. We should abide by appropriate guidelines. But if I am obeying all the rules, why do you have the right to tell me what research to conduct or not? Why do I have the right to tell you what research to conduct or not?

What about dissemination of results? Yes, a university should have a strong statement:

Principle II: Ability to publish

So should the prohibition on accepting grants and contracts with publication restrictions be absolute? We already allow for delays. But while I agree that universities should have a general policy that they do not accept grants or contracts with unlimited publication restrictions, there has to be wiggle room for the rare

exception—not the rule, but the rare exception.

Principle III: Specified Process for Granting an Exception to Principle II

If we grant an exception, then it should be based on a well-defined process. I believe the senior research officer (SRO) and faculty governance, e.g., a standing faculty senate committee, must be involved in such a decision. Then the committee and the SRO should make a recommendation to the provost/chief academic officer.

Why might an exception be granted? Answers to the following questions can provide guidance to making an exception:

- Is this in the nation's best interest?
- Is it in the university's best interest?
- Is it adding value to the student's education?
- Is it adding value to the faculty member's research?
- How much is this going to cost?

In deliberating a proposed exception and in general, I think that there still have to be some outright prohibitions. The overarching principle is:

Principle IV: Protect the students and the campus

"Secured facilities" should not necessarily be banned, but what I call "top secret facilities" should be. Again "top secret facilities" are the ones with fences around them patrolled by those 21-year-olds with Uzis. "Sorry, not only can you not go in, but you cannot know anything about what is going on in there. And if you try to go in, I am authorized to shoot you."

Note the difference between this and a BSL-3 bio-containment laboratory. The door is locked and you cannot just wander in because you want to, but you are allowed to know what is going on in there. And you won't be threatened with shooting if you stupidly try to go in anyway, but the pathogens inside in fact may threaten your life. In other words, the facility is secured because of the danger posed by the materials in the facility. A top-secret type of facility is against the whole nature of the campus. So I propose

Prohibition IVa: Top secret facilities on campus

What about off-campus top-secret facilities? I suggest that any work conducted by faculty members requiring such a facility be done through an off-campus corporate facility and a research sub-contract to the university. Or the faculty can simply consult.

If faculty members are going to conduct research involving classified material at a non-university location, then grants and contracts to support this work should be allowed in general, even though they involve classified material.

I do not like the idea of a classified thesis or dissertation. They are contrary to the nature of an academic institution. Thus,

Prohibition IVb: Classified theses and dissertations

Another problem is ambiguous language. While classified research should not be banned per se, there is a whole realm of ambiguous language that some federal agencies are trying to force on universities. For example, there have been attempts to declare some information "sensitive but unclassified."

These are the contract provisions we should not accept. We should hold firm to the principle that classification is the means by which the government restricts information.

Prohibition IVc: Accepting sponsored agreements with ambiguous language

There are sponsored agreements where the sponsor is classified and cannot be revealed. An agreement can also include a classified budget. In other words, a contract itself is stamped "top secret," for example. I see no need to do that in a university environment. It is true that entities negotiating some intellectual property agreements with a university want the agreement to be private. This is a topic for discussion, and perhaps there is a framework in which to work through such issues. In general, though:

Prohibition IVd: Sponsored agreements wherein the agreement itself is classified

Note that this is different than an unclassified sponsored agreement wherein some of the subject matter of the research is classified.

Finally, and most importantly, we have to ensure that there is no disruption to the educational program of any students involved in the research. Thus:

Prohibition IVe: Disrupting the educational program of a student

Such disruptions could include a delay in the defense of a thesis or dissertation or the inability to build a publication record.

Example of an exception to the policy

Say, for example, that there is a proposed sponsored agreement with an unlimited publication restriction. Although not necessarily the case, further assume that this particular agreement involves classified material in the federal government sense. Assume that the university research team that is proposing an exception to the publication restriction policy for this agreement is quite successful and already has a number of other grants and contracts. They represent a big operation, with many faculty members and many students. In their request for an exception, they make the point that there is plenty of material in their portfolio of grants and contracts for all the students' theses and dissertations, and that there will be no completion delays for the students. And they argue that the proposed work will add value. For example, if the students are aerospace engineers, the faculty members argue that the contacts the students make through the proposed work will provide employment opportunities, and the work will give them credentials that will be important for the type of employment that many of them will pursue after completing their degrees.

Suppose further that the faculty members point out that the additional work will actually result in the publishing of more papers related to fundamental research, rather than fewer, even though the specific classified material cannot be published. (Think of research involving human subjects. Just like the protected health information, you do not reveal the wingspan of the particular airplane.) Yes, there may be classified reports generated by the project, but the number of open literature papers will actually increase. Furthermore, the work is important to the national interest, it will increase the

capability of the research team, and it will enhance the ability of the university to pursue additional research. An exception may be in order and may be in fact a positive for everyone involved.

What if it turns out that a group of researchers begins to abuse the system? They should be dealt with as you would any other faculty member who violates the rules. We should not be creating policies to prevent bad things we think a few bad apples might do and thus restrict the rights of everyone else who plays by the rules. Deal with the bad apples.

Be careful

We must take care that the exceptions do not become the rule. We do not need a Department of Classified Research. Exceptions really do have to be exceptions. As an institution, we have to be firm with deans, department chairs, and directors on publication expectations. This is one place not to make an exception. Arguing that a faculty member did not publish as much as expected because of conducting research involving classified material should fall on deaf ears. In fact, the opposite should be true.

There could be issues raised about international students, if certain research projects are restricted to American citizens. But we already deal with that. Some fellowships are for American students only. At KU, we accepted a contract that did not involve classified material but did restrict participation to American citizens. In this case, we left the decision to accept or reject the contract up to the PI (who was himself not an American citizen), because there was an ability to submit alien participant names to the sponsor and have them, in effect, "cleared." All the international students whose names were submitted (and the PI) were ultimately approved for participation, and they happily went on with their research. We may not like this, given that in basic research there is frankly no need to exclude international students. We can fight in other venues for doing away with it, but we also do not want to limit the ability of faculty and students to conduct their research. We are seeing more of these restrictions arise, and we will continue to.

Summary

Don't specifically ban classified research just because it is classified. In fact, don't even use the term "classified research." Don't ban any type of lawful research. Promote an environment that expects quantity and quality of publications from faculty. Carefully define a process for considering exceptions. If there are outliers, use existing policies to deal with bad behavior.

When dealing with classified research policies, there are often many questions that get collapsed into the single "do it or don't do it" question when in fact there are a number of questions to sort out. The "don't" should really be, "Don't have a classified research policy." Have a "conduct of research" policy. In that policy, adhere to the principles of free and open inquiry of research, to expectation of publication of results, to a clear process for dealing with publication restrictions in sponsored agreements, and to protection of the campus and the students.

Meeting the Science and Engineering Workforce Challenges in the post-9/11 Era

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There is a complex interaction between science and public policy, as public policy can either benefit or hamper scientific progress. The National Defense Education Act (NDEA) of 1958 resulted in the creation of NASA, an agency that has provided funding for the training of thousands of scientists. Our nation has benefited tremendously from this policy. Unfortunately, post 9/11 events—particularly an increased scrutiny of graduate students—have fostered a perception of the United States as an unwelcoming place to pursue graduate studies. This appears to have led to reductions in the number of applications by foreign nationals to pursue graduate studies and postdoctoral experiences in the United States.

Indeed, recent changes to the regulations governing the ability of international students to come to the United States to pursue graduate training in science and engineering disciplines has resulted in notable declines: from 2003 to 2004, the overall number of applications decreased 28%, admissions fell 18%, and enrollment dropped 6%. These reductions are attributed primarily to problems international students encounter obtaining visas.

The availability of science and engineering (S&E) talent has many implications for our global economic competitiveness. The United States has been a global leader for decades. The primary factors in this longstanding global leadership have been the creation of innovation through research and development (R&D) investments in science and technology and the availability of scientific talent. There is a concern our leadership position may be in jeopardy. A number of Asian and European countries are increasing their R&D investments, thus increasing the overall competition for talent. We as a nation have been depending more and more on the international workforce as the number of American-educated students in science and engineering has been on the decline. Restrictive post-9/11 policies have made it increasingly difficult for international graduate students and scientists to come to this country, whether it be to pursue graduate study, work as a visiting scientist, or to participate in international meetings; this enhances the perception that the United States is not as welcoming a place for international students, postdocs, and visiting scientists as in the past.

Current State of the S&E Workforce

Though the United States has been a leader in the number of S&E doctoral degrees granted, other countries are catching up. Alarmingly, the percentage of American S&E doctoral degrees awarded to U.S. citizens/ permanent residents has been on the decline since the early 1980s. In 1966, 78% of all S&E doctorate holders were born in the U.S.; by 2000, that number had decreased to 61%. In addition, the number of S&E doctoral degrees collectively awarded by European countries has exceeded the number of those awarded in the U.S., while the number of Ph.D.s awarded by Asian countries also is on the increase.

Authorship trends of published scientific papers represent an important measure of international standing in science and technology. Since 1966, the number of scientific papers published by authors from western Europe has surpassed the number published by authors from the U.S. Unless these trends can be reversed, more and more R&D will go offshore, moving high paying jobs to other countries.

Talent is Key to Innovation

The Council on Competitiveness asserted in its workforce study that talent is the nation's key innovation asset and recommended building a strong base for scientists and engineers. The study also concluded the demand for scientists and engineering talent far outstrips supply. The number of jobs requiring technical training is growing five times the rate of other occupations, and the average age of the members of the science and engineering workforce is rising. New entrants into S&E fields are not replacing retirees in sufficient numbers. A quarter of the current S&E workforce members are 50 years of age or older, and many will retire at the end of this decade.

Where will the talent come from?

I had the good fortune of serving last year on an ad hoc committee of the National Academies COSPUP committee on Policy Implications of International Graduate Students and Postdocs in the United States. It made me aware of the important role the S&E workforce plays in our future and our global competitiveness. Some of the major recommendations of the report are:

> *The U.S. must maintain its current quality and effectiveness in science and engineering. We should attract the best graduate students and postdocs regardless of national origin. The U.S. should make every effort to encourage domestic student interest in S&E programs and careers.*
>
> *The overarching goal for universities and other research institutions should be to provide the highest quality training and career development to both domestic and international graduate students and postdoctoral scholars of truly outstanding potential.*

Positively, a significant percentage of foreign-born students earning doctorates from U.S. institutions end up staying here, contributing to the

nation's S&E innovation and, subsequently, the economy. This number increased to 71% for 2001 Ph.D. recipients. Recent trends indicate some countries are aggressively recruiting talent back home by increasing their R&D investments.

In order to stabilize and increase our S&E workforce, we must intensify our efforts to prepare and encourage K-16 students to pursue undergraduate and graduate studies in S&E related fields. Lack of interest in S&E begins early, and special emphasis may need to be placed at the middle school level to keep students engaged. American high school students routinely perform below their peers on international mathematics and science tests. Special incentives similar to the NDEA initiative of 1958 must be launched to provide incentives to students to pursue S&E education and careers. Incentives also are critical in reaching out to underserved and under-represented students as they constitute an increasing percentage of our population. The college-age population will be as much as 40% racially or ethnically diverse by the year 2020.

In summary, the United States must attract and train the best domestic and international talent in science and engineering in order to maintain its global leadership position. Without sufficient talent, our ability to provide global S&E leadership is jeopardized.

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Public Policy and Research at The University of Kansas Medical Center

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Public policy has a major impact on research direction at The University of Kansas Medical Center (KUMC). In the past three years, KUMC research leadership has focused on developing programs that are in accord with the aims and goals of (1) world leaders, (2) agencies in the United States that support biomedical research, (3) the State of Kansas, (4) the Kansas City region, and (5) The University of Kansas Medical Center.

World leaders recognize that with the explosive growth in populations, particularly in third world countries, it is incumbent on scientists in developed countries to expand and refine economic and scientific strategies for improving human health. In the U.S., this is reflected in increased support each year for both discovery research and translational research; under National Institutes of Health (NIH) Director E. Zerhouni the emphasis is on translational research. Other agencies with this outlook are the National Science Foundation (NSF) and the U.S. Department of Agriculture.

The State of Kansas is concerned with the health of its citizens, but is also interested in driving the state economy forward by supporting commercialization of discoveries. The Kansas Economic Growth Act (KEGA) is one of the major outcomes of this emphasis on commercialization. This legislation was designed to facilitate the transfer of new developments in research into technology and commercial development in Kansas companies. Its design was driven by the Kansas Technology Enterprise Corporation (KTEC) and now also is a focus of KansasBio, a new organization of Kansas businessmen and academic representatives. Finally, regional support for biomedical research has been building for the past four to five years under the umbrella of the Kansas City Area Life Sciences Initiative, which works with academic institutions and area businesses to bring economic growth to the region through utilization of discoveries in basic and clinical research laboratories.

At KUMC, remaining competitive means staying in accord with funding goals of the NIH; this is critical because the institution receives an additional 47% for facilities and administration in addition to direct research awards and these funds cover many KUMC needs. Commercialization has additional potential for supporting the costs of running the institution.

Raising the question

The drive to use biomedical researchers and their products to increase commercial development is clearly changing the face of research; this raises the question of whether this is beneficial for the future. Will such directives improve or impede discoveries that will lead to improvements in human health and advance research in all fields? The traditional investigator-initiated approach where researchers designed the goals and worked to learn more about how organisms function so as to improve human health is quickly being replaced with the top-down goal of finding uses for research discoveries that will benefit economic growth.

Many researchers are falling agreeably into the new pattern. There are at least two reasons why this is the case. First, biomedical researchers are strongly committed to improvements in human health and would like to see their work bring better health care. Second, because of top-down direction, researchers must now focus on translational aspects of their work in order to win research funding to support their ventures into discovery biomedical research.

The major point of the graph below is that states supply little total support (2%), while most (63%) is contributed by government grants and contracts. Because of the decision by governments that translational research is now the major goal, this drives the aims and goals of research submitted by public agencies. This profile applies to KUMC research, where the university and state contribute little funding to research while strong emphasis is placed on acquisition of extramural funding.

Sources of funding for research: the influence of funding agencies

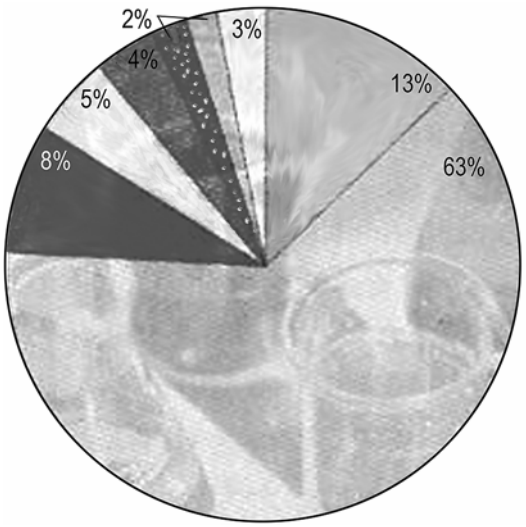


Fig. 1. Funding sources for research at U.S. medical schools and universities

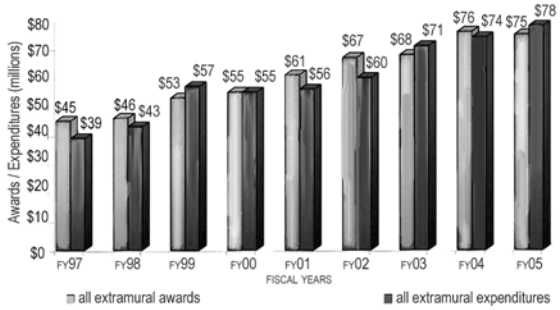
(From *Characteristics of Research Centers and Institutes at U.S. Medical Schools and Universities*, 2005, American Association of Medical Colleges.)

government grants & contracts 63%
university funds 13%
private foundations 8%
industry/corporate funding 5%
endowment 4%
patient care services 2%
direct state funds 2%
other resources 3%

KUMC success in extramural research support

KUMC has competed effectively for extramural research awards. As shown in Figure 2, awards and consequent expenditures have increased each year such that in the eight years from 1997 to 2005 expenditures have nearly doubled. These increases can be attributed not only to exceptional efforts by KUMC researchers, but also to (1) the doubling of the NIH budget that occurred from 1999 to 2003 and (2) infusion of funds from a program carried out by the National Center for Research Resources (NCRR) called the IDeA program, which was established to increase the competitiveness of researchers in the lower half of NIH funding.

Figure 2. KUMC Extramural Funding

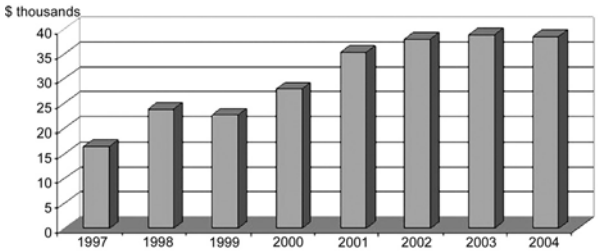


(Note that awards and expenditures do not match exactly; investigators reserve funds for later use.)

Figure 3 shows that KUMC researchers have responded to the directions from the NIH and have received the increases in NIH awards that have occurred in this time period across the U.S. Half of all extramural research awards to KUMC now are NIH awards.

Clinical trials at KUMC are increasing dramatically. In fiscal year '04 there were 85 investigators involved in 260 trials; in FY'05, 111 investigators conducted 393 trials. These trials, which are mainly funded by pharmaceutical and surgical device companies, compose most of the non-NIH research income that is shown in Figure 2.

Figure 3. Growth in KUMC NIH awards



Total DC + F&A NIH awards to KUMC

KUMC basic science departments in the School of Medicine have competed more effectively for the NIH-mandated initiatives than have the clinical departments. As shown in Figure 4, the Departments of Anatomy and Cell Biology; Molecular and Integrative Physiology; and Microbiology, Molecular Genetics and Immunology are strong contenders. By contrast, as Figure 5 shows, only the Department of Medicine among the clinical departments has acquired significant NIH support.

This less-than-satisfactory effort from clinical departments despite the emphasis on translational research followed by commercialization that is now mandated by NIH is believed to be due to several factors, including increased clinical demands to finance physician and support staff salaries. In the past, KUMC did not have a clinical research center. This year a General Clinical Research Center was opened under the direction of Dr. R. Barohn that should facilitate high quality, NIH-supported clinical research.

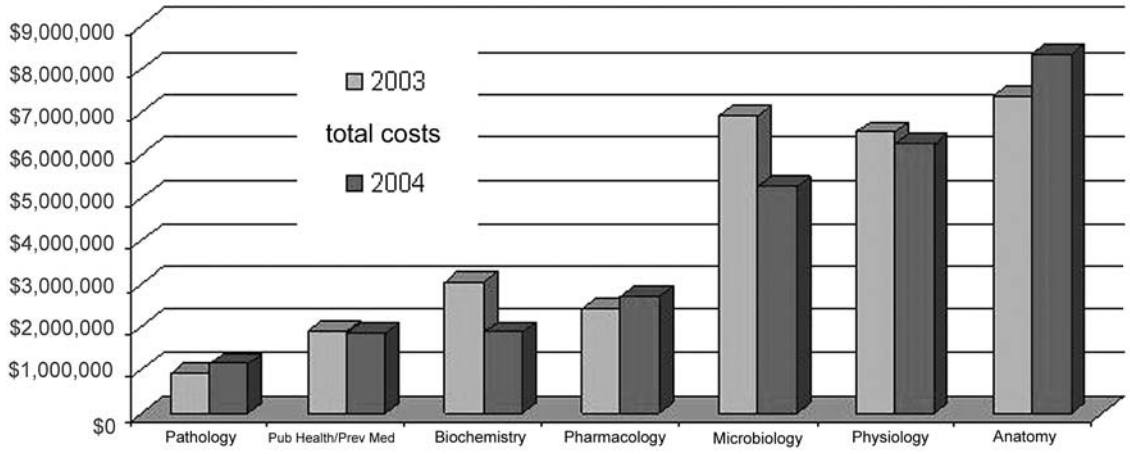


Figure 4. NIH awards to KUMC basic science departments

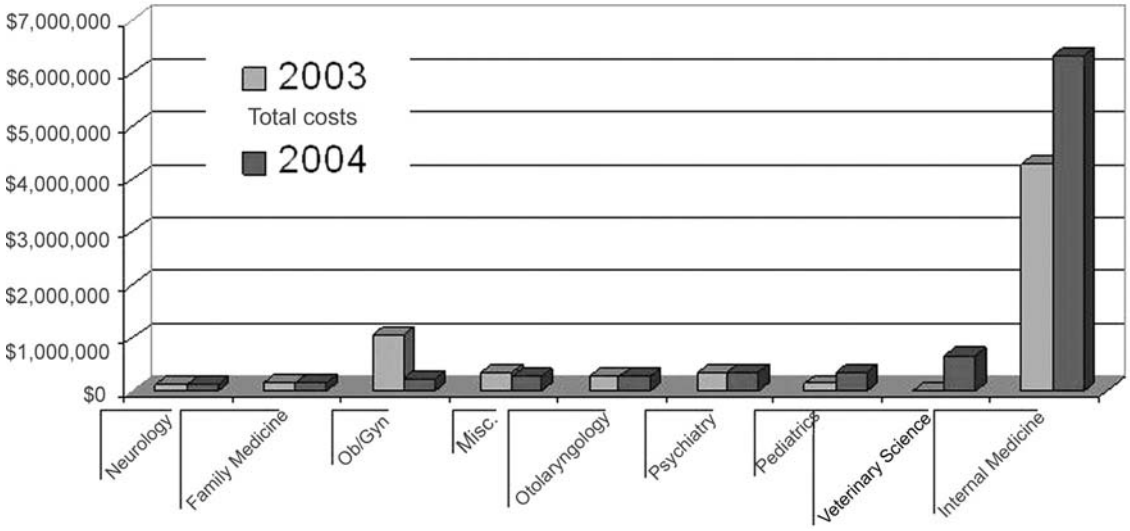


Figure 5. NIH awards to KUMC clinical departments

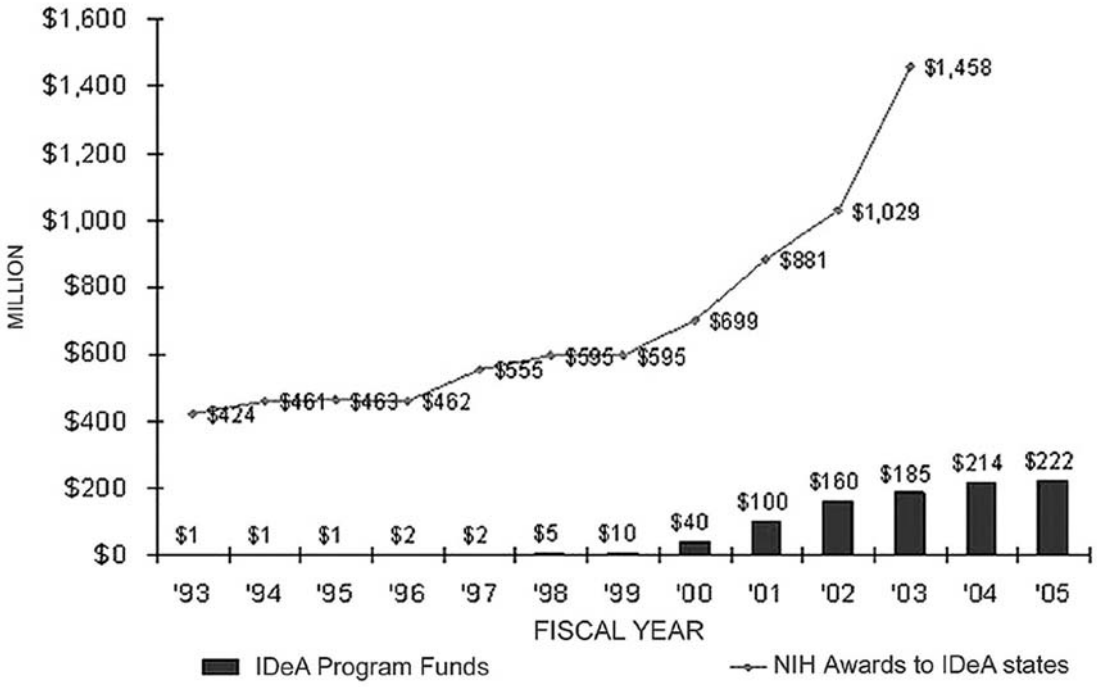


Figure 6. IDeA state NIH awards grow faster than the IDeA award program

KUMC Schools of Nursing and Allied Health compete effectively

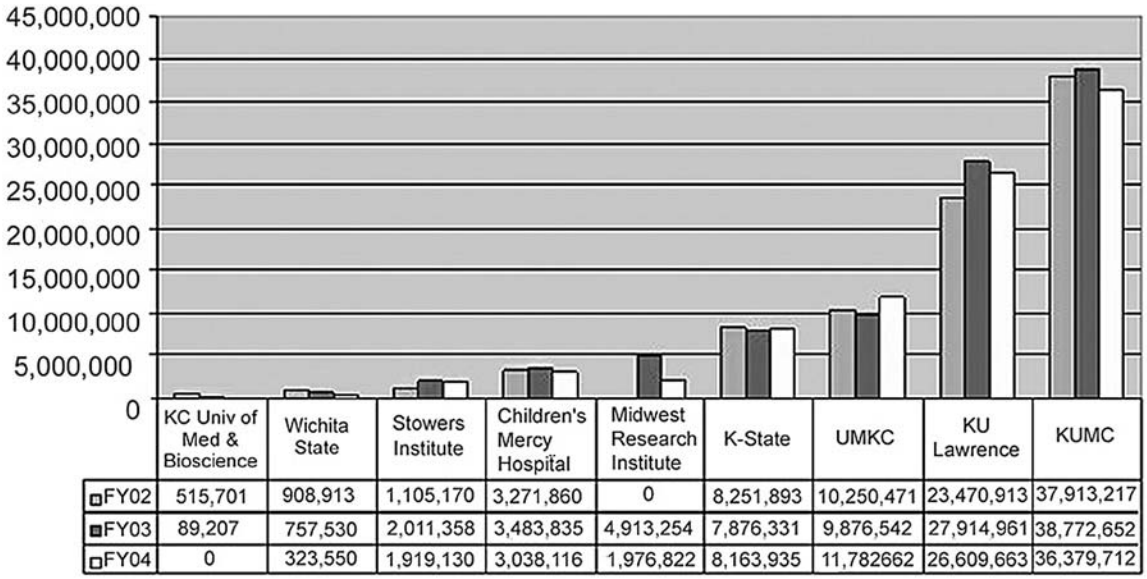
Translational research is well supported in the other two schools at KUMC. Although the NIH research awards are low in the Schools of Nursing ($1,489,000, 2004) and Allied Health ($600,000, 2004) in comparison with the School of Medicine ($34,292,000, 2004), KU Nursing has risen from a ranking of 30 in the list of public universities in 2001 to 20 in 2004 and KU Allied Health has risen from 19 to 13 during the same time period. By contrast, the School of Medicine rank declined between 2001 (43rd) and 2004 (48th).

Although it could be argued that the IDeA program supported by NCRR is largely responsible for the growth in KUMC NIH awards, this is not entirely the case. As shown in Figure 6, IDeA funds have contributed substantially to growth of NIH awards to IDeA states, while overall awards to IDeA states are on a significantly steeper trajectory.

It will be of interest to learn if this trend continues. In Kansas, approximately $75 million in awards have been made through the IDeA program. This includes five COBRE awards of approximately $10 million each to teams at K-State, KU-Lawrence, and KUMC; an additional award is pending for KUMC.

The magnitude of the IDeA awards clearly influences the drive and direction of research at KUMC as all awards in this program are reviewed under the same criteria as other NIH awards.

KUMC has a major leadership role in the State of Kansas as regards acquisition



	KC Univ of Med & Bioscience	Wichita State	Stowers Institute	Children's Mercy Hospital	Midwest Research Institute	K-State	UMKC	KU Lawrence	KUMC
FY02	515,701	908,913	1,105,170	3,271,860	0	8,251,893	10,250,471	23,470,913	37,913,217
FY03	89,207	757,530	2,011,358	3,483,835	4,913,254	7,876,331	9,876,542	27,914,961	38,772,652
FY04	0	323,550	1,919,130	3,038,116	1,976,822	8,163,935	11,782662	26,609,663	36,379,712

Figure 7 KUMC vs. other Kansas universities

of NIH funding. As shown in Figure 7, KUMC leads the state in NIH awards, with KU-Lawrence running a close second and both the University of Missouri and K-State bringing in significant grant awards. Other institutions do not, up until 2004, demonstrate significant income from NIH awards. It appears that because of the inter-institutional IDeA programs, Kansas researchers are more likely to be cooperative than competitive, the reverse of the situation that prevails in many states, and to leave competition to the sports arena.

Research leadership at KUMC

KUMC leadership in research is provided by the research deans of the three schools in cooperation with the Vice Chancellor for Research. Research grants management is a function of the KUMC Research Institute (RI), where, as of January 2005, all pre- and post-award research grant processing is done. The RI is guided by an Executive Director who is also Associate Vice Chancellor for Research Administration and a Board of Directors that includes both university and community members. The RI is composed of several divisions, some of which oversee clinical research, technology transfer, intellectual property, and commercialization.

Research areas of focus

When compared with many medical centers, KUMC does not have a large contingent of researchers. As a consequence, the university has chosen to focus on a few areas where strength has already emerged. Figure 8 shows that Cancer, Reproduction, Neuroscience, Kidney and Liver research command good to outstanding funding. All of these areas also have major potential for trans-lational research and commercialization.

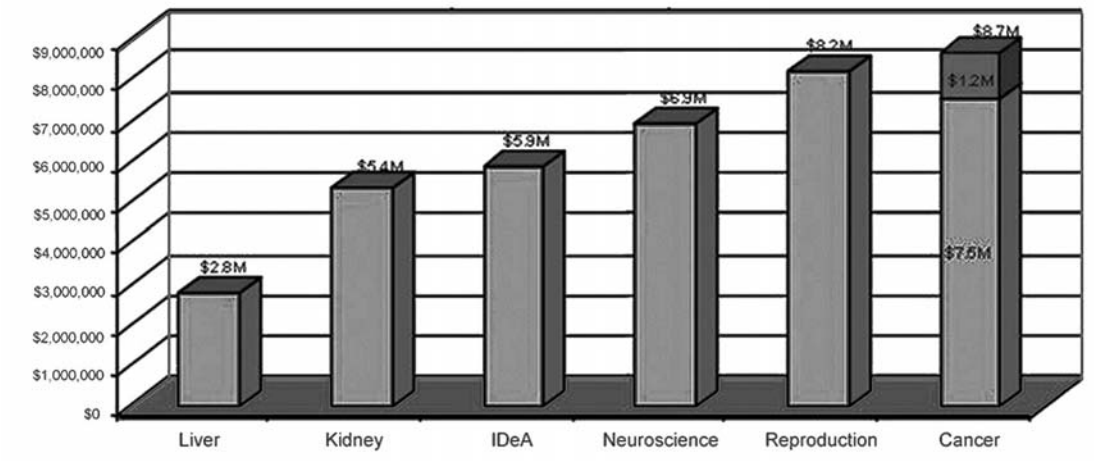
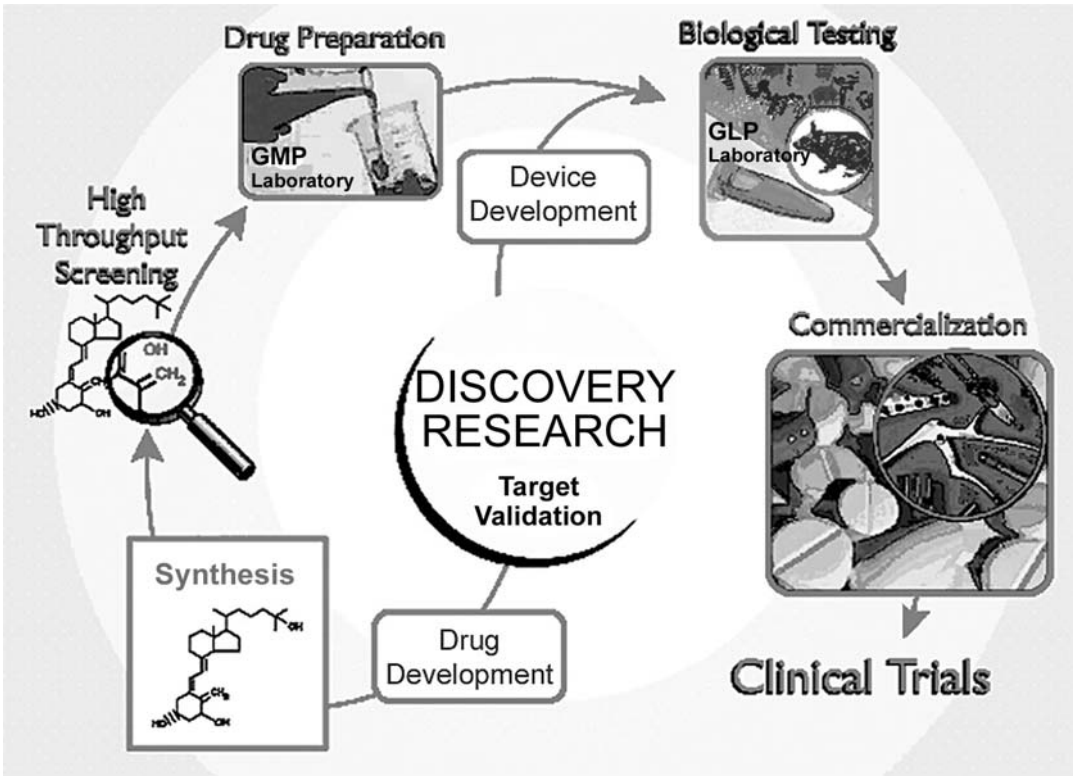


Figure 8. Funding of KUMC major research areas

The development of an NIH-supported Comprehensive Cancer Center is a major focus of the KUMC research program. This program partners importantly with the KU-Lawrence campus through its Experimental Therapeutics Program. As shown in Figure 9, drug development for cancer treatments is facilitated by the high throughput screening facility in medicinal chemistry that is supported by an NIH IDeA grant. Drug development takes place on both campuses: KU-Lawrence is in charge of the chemistry and initial testing (left half of figure), while KUMC handles the clinical aspects (right half of figure).

Figure 9. Drug development



Research in the Reproductive Sciences is concentrated in the NIH-funded Reproductive Sciences Center, Mental Retardation Research Center (MRRC), and Institute for Maternal-Fetal Biology, as well as a newly developing effort to expand gametes and embryogenesis. Neurosciences come together in the Center on Aging, Alzheimer's Disease program, the Amyotrophic Lateral Sclerosis program, the MRRC, and a Parkinson's disease center. In kidney research, new clinical and basic science researchers have joined the Kidney Institute, and the same is true in liver research, where a new center is being built.

Building support

The paragraphs above document the new direction for health-related research in the U.S. and the successful efforts of KUMC to continue competing effectively for the funds that have been put in place to facilitate translational research and commercialization. In addition, the university is building a new 205,000 sq. ft. biomedical research center to be opened in late 2006, has been actively recruiting 177 replacement and new faculty in the past three years, and has developed more active outreach or community-oriented efforts to acquire additional extramural support, such as publication of the outreach research magazine *Research in Medicine*.

In summary, KUMC research remains in accord with the stated aims and goals of world leaders, national research funding agencies, and areas of emphasis in our state and region. Whether this will lead to more innovative and imaginative research in the long term remains an open question.

University Bioscience Research and Regional Economic Development: You can't always get what you want . . . you don't always get what you need

Lessons learned by an ACE Fellow in Buffalo, NY

Lisa C. Freeman

Associate professor and Director of Mentored Training
College of Veterinary Medicine, Kansas State University

The view that federal investment in biomedical research can lead not only to improved physical well-being, but also to economic prosperity was advanced by Vannevar Bush in his 1945 report, *Science the Endless Frontier*: "Advances in science when put to practical use mean more jobs, higher wages, shorter hours. . . . Advances in science will also bring higher standards of living, will lead to the prevention or cure of diseases, will promote conservations of our limited national resources, and will assure means of defense against aggression. . . . Science, by itself, provides no panacea for individual, social and economic ills. It can be effective in the national welfare only as the member of a team whether the conditions be peace or war. But without scientific progress no amount of achievement in other directions can insure our health, prosperity and security as a nation of the modern world."[1]

Today, the Federal Government is the largest supporter of academic-based research in the life and health sciences.[2,3] In return for this investment of tax revenue, Americans expect steady progress in development of safe and effective diagnostic tests, surgical procedures, vaccines, drugs, and devices. Moving academic research from "bench to bedside" has demonstrable benefits for individual investigators, universities, companies, and general public. In fact, Americans today benefit from both the advances in health-related technology and the economic expansion that result from technology transfer.

Passage in 1980 of the Bayh-Dole Act served as a major stimulus for expansion of technology transfer by universities and academic medical centers.[2-5] This legislation gave universities the right to own and license their inventions that result from federally funded research. It has been estimated that university research contributed significantly to the development of 27% of the new products and 29% of the new processes commercialized by pharmaceutical companies in the 1980s.[6] For example, academic inventions with substantial public health significance include: the anti-cancer drugs cisplatin and carboplatin (Michigan State University); the prostate specific antigen (PSA) screening test for prostate cancer (Roswell Park Cancer Institute); the

vaccine for hepatitis B (University of Washington); the anti-HIV drugs lamivudine and emtricitabine (Emory University).[3,7-8] University researchers have also played a key role in establishing biotechnology companies, such as Genetech, Chiron and Biogen.[7]

In 2003, universities received 3179 new patents and spun off 348 companies. Still, there is significant concern that translational research and technology transfer occur too slowly.[4,9] Intellectual property that is developed in academic laboratories, but not disclosed nor developed represents a loss to society—a failure to fulfill the dream of Vannevar Bush. At the federal level, recent attempts to remedy this have focused largely on facilitating basic research breakthroughs and accelerating the speed of translation of those discoveries into clinical practice. The most notable initiative is the NIH Roadmap, with its three major themes: new pathways to discovery; research teams of the future; re-engineering the clinical research enterprise.[9]

The emphasis of regional and state governments is decidedly more focused on economic health than on preventing or curing disease.[10] When the governor of New York announced in 2001 the formation of a Center of Excellence in Bioinformatics at the University at Buffalo (UB), the assembly speaker said:

> "Supporting projects such as the Center of Excellence at the University at Buffalo is a proven strategy for job creation and for the long term economic well-being of our communities." [11]

A local assemblyman echoed:

> "The UB Center of Excellence is an excellent example of how State government can help turn Western New York's economy around and make us a player in the global economy of the future. The project will help transform innovative ideas developed at our local colleges and universities into the good-paying jobs that will help more families put down roots in our region."[11]

Numerous regions are looking to local research universities to help them become national centers for life sciences research and industry. More than 40 states are pursuing a bioscience agenda as a statewide goal.[10-13] A 2001 survey of state government initiatives found that state strategies for support of the biosciences include tax credits and incentives, direct investments in research, technology and education infrastructure, and other measures aimed at improving the business climate for biotechnology start-ups.[13]

Even though the biomedical research enterprise is relatively widespread and there is growing interest by the states in leveraging university research into economic development, however, only a handful of the United States' largest metropolitan areas have demonstrated real success. Among the country's 51 largest metropolitan areas, nine regions account for the bulk of economic growth in biotechnology:[12]

- Boston (including Worcester-Lawrence, MA)
- San Francisco (incl. Oakland-San Jose, CA)
- San Diego, CA
- Research Triangle, NC (Raleigh-Durham-Chapel Hill)
- Seattle (incl. Tacoma-Bremerton, WA)
- New York (incl. Long Island, NY, and Northern NJ)
- Philadelphia (incl. Wilmington, DE, and Atlantic City, NJ)
- Los Angeles (incl. Riverside and Orange County, CA)
- Washington DC-Baltimore, MD.

Moreover, even these successful biotechnology clusters have produced only modest returns to local economy.[12] What do these data suggest for the areas looking towards a life sciences corridor for economic salvation? According to Mark Collar, president of the Global Pharmaceutical Division of Procter & Gamble: "There are going to be winners and losers. There aren't going to be 83 biotech epicenters in the United States."[10]

Winners vs. Losers

What determines whether a regional bioscience initiative will be the road to riches or a boulevard of broken dreams? The challenges facing aspiring regional biotechnology centers are significant and include: fostering a climate conducive to university spin-offs on campus and in the community, attracting adequate amounts of venture capital to move an idea from "mind to market," and developing a local workforce suitable to the life-sciences industry. When local officials assess their potential for success, they may overestimate the adequacy of existing resources and infrastructure, underestimate the time required for return on investment, and thereby foster or fuel unreasonable expectations.

Establishing Research Infrastructure

Realistic consideration of the infrastructure available to support a biosciences cluster must take into account the available research base, capital flow, and labor force. In 2002, the nine established US biotechnology corridors accounted for of 59% of NIH funding, 68% of biotechnology patents, 92% of active biotechnology venture capital firms, and 75% of biotechnology start-up firms.[12] Whereas biomedical research activity became more dispersed during the fifteen years between 1985 and 2000, patents, capital flow and the growth of biotechnology firms became more concentrated over the same time period.[12] Productivity in research and life sciences education is necessary but not sufficient for success in economic impact. Chicago and St. Louis are examples of metropolitan areas with high levels of research activity but below average levels of commercialization (Table 1). Buffalo and Kansas City are examples of aspiring biosciences corridors facing real challenges across the spectrum of research infrastructure (Table 1).

The North Carolina Research Triangle, San Diego, and Seattle were latecomers to biotechnology and boom. Each has above average levels of research activity, but all three are relatively stronger in commercialization than in research. These regions were tremendously successful in generating new ventures and attracting capital during the 1990s, and their emergence as biotechnology centers reflects these achievements.[12] It is important to recognize that significant financial investments contributed to the successes of the Raleigh-Durham-Chapel Hill, San Diego, and Seattle metropolitan areas. Each of these areas has had an average of $500 million in NIH funding annually for more than a decade, combined with $750 million in new venture capital during the past 6 years.[12]

Table 1. Research Infrastructure Comparison*

Metro Area	Bioscience PhDs granted 1999	$ NIH Funding 2000	# Patents 1990-99	$ Venture Capital Investment 1995-2001
Boston	355	1,422,875,474	3,007	1,915,654,300
San Francisco	215	703,529,044	3,991	3,028,917,500
San Diego	82	680,954,889	1,632	1,505,896,000
NC Research Triangle	166	469,119,754	796	379,687,000
Chicago	177	416,777,457	1,444	61,837,000
St. Louis	173	324,015,608	780	8,800,000
Buffalo	45	61,504,692	129	0
Kansas City	11	27,921,183	103	12,000,000

*Data excerpted from reference 12.

Interestingly, the pathway to prosperity was not identical for the upstart regions. Cutbacks in the defense industry left San Diego with a plethora of talented engineers, scientists and managers attached to the area and in search of new challenges. The University of San Diego was highly successful in transferring technology out of university laboratories and into companies, because of the availability of this unique workforce.[14] In the North Carolina towns of Raleigh, Durham and Chapel Hill, there were major research universities producing doctoral level bioscientists and no places for them to work in the state. In contrast to San Diego's strategy of advancing home-grown entrepreneurs through technology transfer, North Carolina developed a strategy based on recruitment and relocation of successful biotechnology ventures.[14] In the 1990s, a number of recruiting organizations such as the North Carolina Biotechnology Center focused their efforts on bringing big name biotechnology firms to Research Triangle Park by offering facilities an unusual variety of opportunities for formal and informal collaboration with the universities.

It is notable that the strategies used by San Diego and Research Triangle, NC, were focused beyond merely bolstering academic research funding and activity. In each case there was a long-term plan built around existing strengths and based upon support of sensible strategic partnerships, promotion of private capital investment, and encouragement of local entrepreneurship. These are key components of effective programs.

In metro areas like Buffalo and Kansas City, where traditional industries are outside of science and technology attracting private capital investment may represent the most significant challenge. Biotechnology is both expensive and risky. Funding for early stage technology, is difficult to obtain under any circumstances, and this investment gap is

worse when market uncertainty is heightened by lack of investor proximity and lack of regional experience with commercialization of academic inventions.[10-15] In regions like these, it will be important for state and local initiatives to provide support for mid-to-late stage funding for development of products with commercial potential, to offer business development assistance, and to invest in workforce development. Academic institutions and established corporations also have the potential to contribute in these areas. Increasingly, universities are making venture funding and campus-based business expertise available to new life science companies.[16,17] Innovative corporate partnerships are allowing for enhanced educational opportunities in entrepreneurship and professionalism.[18]

Managing Expectations

Entrepreneurs and executives are highly susceptible to cognitive biases that lead to inflated self-confidence and an exaggerated view of their own power to influence complex series of events.[19] Organizational and political pressures to emphasize the positive and downplay the negative may also contribute to overoptimistic forecasts.[19] Unfortunately, the net result is too often a shared unrealistic view of future outcomes for major initiatives.

Many, if not most strategies to leverage university innovation into regional economic development suffer from this type of "delusional optimism." In this context, the results are flawed decision making and unreasonable community expectations. This phenomenon was evident at establishment of the Center of Excellence in Bioinformatics at UB.

As noted in the previous section, the formation in 2001 of the UB Bioinformatics Center of Excellence was a major step in an integrated plan for building a life sciences economy in the Buffalo-Niagara region of western NY. The Center was launched with a federal investment of $27 million, a state investment of $50 million, and corporate pledges for $150 million dollars. Early on in the life of the Center, its power as an engine of economic development was oversold, not only by politicians but also by academic and community leaders:

> "Buffalo has some unique strengths. The money for the new Center of Excellence in Bioinformatics will allow us to take those strengths and turn them into an economic engine for this area."
>
> Senior Associate Dean, UB School of Medicine[20]

> "A not-for-profit group called Bufflink that is working to foster a life sciences economy in the region estimates drug development work could create 5,000 to 8,000 jobs over the next several years." [21]

Projections based on realistic benchmarks were advanced only after significant media attention was paid to shortfalls from projections:

> "The Center missed initial projections of creating 4000 or 5000 spin-off jobs. Bufflink has tracked over 1000 jobs in the life sciences in the past few years, although not necessarily linked to the bioinformatics center."
>
> Buffalo News, 2005[22]

> "It's a difficult and challenging proposition to expand a region's economic base from one anchored traditionally in manufacturing to one that includes a life-sciences foundation; experience in other parts of the U.S. has shown it takes years for this occur."
>
> UB President, 2005[23]

The exuberant expectations for the UB Center of Excellence in Bioinformatics reflect over-optimism and result directly from the planners reliance on what Lovallo and Kahneman have called an "inside view."[19] The initial projections were based on knowledge of goals and resources, and imagined scenarios of progress. It is likely that more realistic expectations would have been generated by taking an "outside view" and adopting "reference class forecasting."[19] The latter approach ignores the details of the project at hand, and instead uses the experiences and outcomes of a class of similar projects to gauge the current position and forecast the future course.

The advantage of an outside view is most pronounced for large scale initiatives where the planners lack experience.[19] This is almost always the case for state and regional efforts to leverage academic research into economic development. Fortunately, precedents that can be used for reference class forecasting exist and are accessible. Comparison data similar to Table 1 can be excerpted from the surveys and reports generated by the Association of University Technology Managers (http://www.autm.net/index.cfm), the US Bureau of Census, the federal agencies that provide research funding to universities (NIH and NSF), TheCenter (http://thecenter.ufl.edu/), and the numerous for-profit and not-for-profit organizations that review the bioscience industry.

Implications

Optimism generates more enthusiasm and commitment than realism. Significant instability and lack of trust may be induced or exacerbated by promoting unrealistic expectations in the context of a state bioscience initiative. In these projects, it is typical for the alliances to be uneasy; the agendas to be in conflict; and the resources to be inadequate. Impatience is common where persistence is needed.

In truth, establishing a new biosciences corridor is a challenging, long term proposition. Regardless of where the journey ends, one can expect to encounter a long hard road with many obstacles, detours and potholes. Success will be driven by significant investment in research infrastructure, realistic long-term planning, and appropriate management of expectations.

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Science and Public Policy, Historically Speaking

James A. Guikema
Associate Vice Provost for Research, Associate Dean of the Graduate School
Kansas State University

Once again the theme of this Merrill Conference is timely; multiple public policy issues are having an impact on the enterprise of scientific research. Some of these issues impose systemic limitations on the 'how' of our research activities. For example, several years ago at this conference, we discussed constraints imposed by the Student and Exchange Visitor Information System (SEVIS) regulations and the impact on research and training of foreign national graduate students. These restrictions continue, and international student applications to U.S. graduate schools are at an all-time low. Others of these issues seek to limit the 'what' of our research efforts. An example raised by many speakers at this conference has been the use of human embryonic stems cells in biomedical research.

This text takes a slightly different approach by examining historical examples where public policy decisions collided with the science research enterprise. I am not a historian; this is a biologist's look at history. Yet it is important to realize that national administrative decisions can profoundly focus our enterprise, even as we seek to provide our policy makers with decision-quality information. Therefore, through the perspective of history we will focus on two obvious questions—which lead to a research compliance concern.

Question 1: Can policy decisions shape the future of science?

The answer to this question is, quite obviously, yes. Government largely provides the funding for scientific research, and despite the concept of peer review Washington feels free to set research agendas. For example, why does the Navy fund a major cancer research program?

Choice of the historical example highlighted in this talk was motivated by two crown jewel resources available here in the Midwest: the Eisenhower Library and Museum in Abilene, Kansas, and the Kansas Cosmosphere and Space Center (KCSC) in Hutchinson. K-State was fortunate to host a number of undergraduate research scholars during the past summer, and the K-State Graduate School invited them on a trip to the KCSC. KCSC tells a remarkable story of the U.S. commitment to the space program. Much of this commitment grew during the Eisenhower presidency—as is reinforced by exhibits at the Eisenhower Library and Museum—and it certainly led the way to the robust science programs we see today.

The Eisenhower presidency made a major decision that set the stage for initial losses in the space 'race,' which I believe set the stage for the larger victory. The decision had its roots in events during World War II. In February 1945, Stalin, Churchill, and Roosevelt met to divide Germany. Stalin was ecstatic, since the Russian zone would contain the major weapons and missile development region: Peenemünde.

Churchill, Roosevelt and Stalin at the conference in Yalta at which the fate of Germany was decided. (NASA file photo.)

In June of 1945, however, Dr. Warner von Braun surrendered to U.S. troops, and Secretary of State Cordell Hull approved moving von Braun, 126 members of his staff, and 300 train cars of V2 rockets and missile parts to the U.S.. Stalin was furious and launched an aggressive missile development program immediately following the war.

When Eisenhower assumed the presidency, there were two groups—the Army (von Braun et al.) and the Navy—who were active in missile development. Eisenhower added a third—a civilian effort that later became NASA. Further, he mandated that *any progress in orbital spaceflight be made in a civilian effort*.

Though in ancient times Seneca (4 B.C.-39 A.D.) wrote, "There is no easy way between the Earth and the stars," von Braun made tremendous progress from 1948 to 1954 with the Redstone rocket. Yet in 1955 he was told in no uncertain terms to stop all efforts in satellite launch. Eisenhower announced an orbital flight program in 1956, with the disaster-prone Vanguard program in the lead. On May 22, 1956, the Secretary of Defense announced that "there are no plans or preparations using Redstone or the new Jupiter missiles as launch vehicles." Von Braun's team was shut out, despite overwhelming superiority, because it was a military, not civilian, operation.

On September 20, 1956, a Jupiter C rocket achieved escape velocity, but did not have permission to orbit. In August 1957, a Jupiter C nosecone was retrieved—the first ever recovery following spaceflight (again, no orbital permission). Jules Verne said that "Anything that one man can imagine, other men can make real." The Soviets proved the saying by launching Sputnik I (October 4, 1957) and Sputnik II (November 3, 1957), and the U.S. lost the space war: part 1.

In a complete reversal, on November 7, 1957, Eisenhower announced that the Jupiter (von Braun's) program had solved all of the U.S. problems and that orbital flight was near. In January of the following year, Explorer I was launched; it put into orbit a radiation sensing payload developed by a University of Iowa colleague, Professor James van Allen.

Dr. Warner von Braun (far right), Jet Propulsion Laboratory Director James Pickering, and State University of Iowa Professor James van Allen showing a model of Explorer I following the first successful U.S. orbital missile launch. (NASA file photo.)

The U.S. lost phase one of the space race because of Eisenhower's pro-civilian policies. Kennedy, however, needed to reclaim international leadership. He asked his staff to recommend strategies, and Lyndon Johnson provided the answer–put a man on the moon. The Apollo program had begun.

Tribute to the last footprint left on the moon in 1972 at the Kansas Cosmosphere & Space Center. (Personal photo by the author.)

The last human footprint on the moon occurred on December 13, 1972, left by Apollo 17 commander Cernan. (Coincidently, University of Kansas graduate Ronald Evans was on the mission.) Would we have gone to the moon if Eisenhower had won the race to orbital spaceflight? I think not.

Question 2: Can (bad) science shape the future of public policy?

For a historical example of science shaping public policy, I turned to our Vice Provost for Research, Dr. R.W. Trewyn for a suggestion. His suggested example illuminates activities during the Viet Nam War, when the U.S. extensively used defoliants like Agent Orange to deny terrain to the enemy.

Dr. Trewyn was asked to be a consultant on a study of the health effects on soldiers involved in herbicide

application. The accompanying photo shows that little personal protective equipment was used, and that adverse conditions such as prop-wash from helicopters did not deter spraying. As

The spraying of herbicide—likely Agent Orange—in Viet Nam without the use of personal protective equipment. (U.S. Army file photo)

part of his efforts, Dr. Trewyn was asked to testify to the National Affairs, Veterans Affairs, and International Affairs Subcommittee of the House Committee on Governmental Reform. The focus was on the Air Force Ranch Hands Study on the Health Effects of Agent Orange (March 2000). And his message was this: the study was flawed, because the control group was inappropriate.

The U.S. government had based its treatment of veteran soldiers on a flawed study. Even though the flaws were unearthed, the science team refused to change the parameters during the two decades of the study. Bad science helped to create bad policy.

Are there implications for the research administrator?

As mentioned earlier, my last presentation to this audience concerned SEVIS and its impact on our international graduate student clients. My example addressing this question involves foreign-born students as well, but the impact is on our faculty scientist, not on the student.

Export control regulations are not new. Rather, they are decades old and they have their roots in political differences amongst nations. Export from the U.S. is liberal to Canada and Mexico, but almost nothing can be exported to Cuba or North Korea. The political climate for the university researcher changed dramatically, however, in 1994, when information—the results of university scientific research—became an export commodity.

Export Administration Regulations (EAR) are administered by the U.S. Department of Commerce and regulate items that could be mutually used for business or for defense (such as global positioning systems). International Traffic in Arms Regulations (ITAR) are administered by the U.S. Department of State to regulate weapons and related items. EAR violations can result in faculty members being fined up to $1 million and 10 years imprisonment, while ITAR violations can result in $100,000 fines and two years imprisonment. The faculty member, not the university, is personally liable.

Since 1994, the concept of 'deemed export' has come into play. Simply put, in order to convey restricted information or protected software code to a foreign coworker (undergraduate student,

graduate student, postdoctoral, or faculty colleague), one must first obtain an *export license*. The restrictions come into play when faculty members accept research contracts/agreements which (a) contain limitations on publishing the findings of research, (b) are based on the sponsor providing sensitive or confidential information which will not be published, or (c) are classified by the government.

EAR, ITAR, and the concepts of deemed exports mean that universities must add a layer onto their research compliance activities. At Kansas State University, we have begun that process.

Research Compliance Challenges

Robert D. Hall
Associate Vice Provost for Research
University of Missouri-Columbia

Compliance with an increasing number of federal and, to a lesser extent, state laws and regulations is a significant issue for all major research institutions. It consumes resources today at an increasing rate and burdens investigators with administrative requirements that compete with their academic pursuits. Areas where compliance issues are currently significant include human subjects research, research involving animals, conflict-of-interest, research integrity, and related research areas such as biological safety and export controls. All of these compliance areas serve as resource-allocation challenges for research administrators seeking to maximize the total campus impact of increasingly-scarce funding. Further, they exist to foster the public policy of conducting research in a safe and ethical manner.

Human subjects research, review by Institutional Review Boards (IRBs), and potential federal sanctions have been front-page news for the past five or six years. Most institutions seeking federal funding have augmented their human research protection programs, often at the expense of other priorities. At the University of Missouri-Columbia (MU), we have gone from two part-time IRB administrators to ten full-time personnel supporting our two boards. Still, we need additional staff if we are to respond successfully to the major issue considered critical by our investigator population: time-to-approval of protocols. To complicate matters, we are currently engaged in IRB accreditation through the Association for Accreditation of Human Research Protection Programs (AAHRPP). Our involvement in the accreditation process at this point is a by-product of our affiliation with a collocated Veterans Administration hospital, but we hope that the expense and time expended in accreditation will eventually be worth the investment. On the health-sciences side of the house, we desperately need additional attention to billing compliance and audits of clinical trials—both areas fraught with the opportunity for regulatory disaster. One point of continuing investigator anxiety is that of training. We continually refine our on-line web sites and training modules to reflect the reality that scientists and faculty in general don't like to be "tested."

Animal use in research presents another fiscal challenge that daily confronts MU's research administration. A recent review by an external panel

demonstrated that MU has (in 2003 dollars) about $97 million in research-animal infrastructure needs. Coupled with an estimated $70 million in plant-growth-facility needs, this represents a major fiscal hurdle for the campus. In addition, we have had to deal with startup costs for our Life Sciences Center vivarium as well as funding service-and-maintenance contracts for the equipment therein. Similar to human protection program accreditation, the Association for Assessment and Accreditation of Laboratory Animal Care, International (AAALAC) provides accreditation for MU's animal research facilities, except for those in the College of Agriculture, Food and Natural Resources (CAFNR). Bringing CAFNR under the AAALAC umbrella has generated much consternation regarding potential costs and benefits. In addition, per diem charges and electronic veterinary medical records are two areas where much effort recently has been expended, as it has been on the issue of investigator training in both basic animal-care as well as specialty areas. Presently, MU invests considerable staff time and effort in self-disclosing animal-care compliance issues to DHHS's Office of Laboratory Animal Welfare. Of perhaps greater concern is administration of our Occupational Health-and-Safety Program for research animal workers. Mandated by our Collected Rules and Regulations (CRRs), enrollment in the program is required for MU employees and students, but the university's role is less clear in regard to non-MU employees (such as federal scientists and technicians) conducting research on campus under a variety of memoranda-of-understanding.

Conflicts-of-interest have raised compliance antennae nationwide over the past several years, especially as an offshoot of well-publicized controversy at the National Institutes of Health. MU currently has two conflict-of-interest policies in its CRRs: one is a "general" statement most directly applicable to individual financial conflicts in the typical business context, and the other resulted from the mid-'90s mandate that PHS or NSF grantee institutions maintain an appropriate written and enforced policy on conflict of interest consistent with provisions in 42 CFR Part 50 and 45 CFR Part 94 and the NSF Grant Policy Manual. The existence of these two policies has produced an interesting result, in that the aforementioned "general" policy proscribes MU employees using their university status in engineering contracts with outside business entities in which such employees have a "direct or indirect financial interest." This "direct or indirect" threshold has been interpreted to apply also in the context of research grants. It is the federal de minimus standards which appear in the second policy and on MU's grant-data form, and thus investigators who may in fact have a "direct or indirect" financial interest that does not exceed $10,000 per annum or five percent equity may fail to disclose and thus be out of compliance with the general policy. Readers whose campuses are members of multi-campus university systems will appreciate the cumbersome nature of getting such policies revised. In addition, neither policy addresses the issue of institutional conflict-of-interest, which failing will become apparent as MU's IRBs move forward toward

AAHRPP accreditation. Our campus Conflict-of-Interest Committee coordinates well with our IRBs because the IRB compliance officers sit as ex officio members on the former committee. A challenge remaining for this committee is effective annual review and audit of those management plans it has required.

Research integrity remains bright on the radar screens of university research compliance officers. As expected, the federal Office of Research Integrity within DHHS has recently promulgated both amended definitions of scientific misconduct and a revised policy for responding to allegations of research dishonesty. The University of Missouri policy has in turn been revised and the draft submitted for review, comment and action by System officials. Further concerns focus on the currently-suspended Responsible Conduct of Research (RCR) initiative from DHHS and how much faculty time eventually will be absorbed both presenting and taking the required courses of instruction. A recent report[1] suggests that the amount of research misconduct actually occurring at U.S. universities may be underestimated, supporting the ongoing educational efforts focused on RCR.

Related compliance areas currently taking considerable MU time and resources include biological safety and the Institutional Biosafety Committee (IBC). Recent federal guidance indicates that all recombinant-DNA research proposals should be reviewed at a convened IBC meeting, and further that such meetings should be open to the public when practicable. Similar compliance committee meetings have not traditionally been open to the public, nor have their minutes been accessible via state open-records law. The USA Patriot Act appears to have sufficient congressional support to continue generally un-amended; thus, rules applying to Select Agents will remain a part of research compliance into the foreseeable future.

At MU, we are fortunate to be home to the nation's most powerful research reactor, with the attendant radiation safety and Nuclear Regulatory Commission issues. Our Radiation Safety Committee constantly engages in oversight of radioactive isotopes on campus. Hazardous materials management is a collateral area that requires constant attention, and MU's Office of Research partners with the campus office of Environmental Health & Safety in managing biosafety, radiation safety, and hazardous materials handling.

Export controls loom as the single regulatory issue in university research compliance with the potential for significant resource allocation in the immediate future. Although current export control regulations have been in place for many years, universities have traditionally relied on what is known as the "fundamental research exclusion" to exempt the majority of research projects from Department of Commerce licensing requirements. In fact, a quick review of existing export control regulations reveals that these are complicated rules administered by three major federal departments: Commerce, State and Treasury. Whereas patently military

[1] Martinson, B.C., M.S. Anderson & R. de Vries. 2005. Scientists behaving badly. Nature 435: 737-38.

technology, governed by Department of State through International Traffic in Arms Regulations (ITAR), is generally easily recognized, the so-called "deemed export" rules of the Export Administration Regulations (EAR) administered by the Department of Commerce are in practice much more difficult to apply. "Dual use" technology appearing on the Commerce Control List (CCL) implicates an appropriate license when such technology is even discussed with a non-U.S. citizen or non-permanent-resident from any of the countries listed on the Commerce Country Chart, unless such interaction occurs as part of fundamental research that is currently excluded under National Security Decision Directive 189. To date, universities have focused on those actions that will preserve their excluded status, such as refusing to accept restrictions on publications, refusing to accept restrictions on access by foreign nationals, and so forth. However, Commerce recently completed the notice-and-comment portion of a proposed rulemaking that would change the definition of equipment "use" and require as well that the country of birth be used to evaluate the license requirement on the Commerce Country Chart, rather than the country from which an individual emigrated to the United States. Compliance with existing export control requirements will require reallocation of existing administrative staff by almost all research institutions; compliance with the proposed changes, should they be implemented, will require a significant investment in additional staff. Similar changes to contractual language have recently been proposed by the Department of Defense. Not yet discussed in most national educational media is the provision of "services" to foreign nationals from those countries listed by the Office of Foreign Assets Control in the Department of Treasury.

Coming hard on the heels of recent compliance challenges in human subjects oversight, research animal welfare, and biologicals under the Patriot and Bioterrorism acts, the potential for additional staff in any administrative compliance function will be hard to justify to hard-pressed senior administrators. At MU, our system-wide leadership has called for a reduction in administrative positions, and so it is unlikely that we will be able to add significant staff absent some sort of emergent situation. However, that prospect does raise an important public policy question: "Where will the institution get the wherewithal to meet these significant new compliance challenges?" At MU, the recurring rate budget needs of compliance compete directly with needs for recurring faculty rate, although many of the most significant compliance issues relate primarily to the institution's research function. It is further a fact of life at our institution that we have long since exceeded the 26% administrative cap on facilities and administrative (F&A) costs: MU's actual costs in this category currently exceed 32%. One option might be to suggest again that the federal government acquiesce to increasing the administrative cap. Using current MU fiscal data, an increase of 1.5% (to 27.5% of the negotiated rate) would result in recovering an additional $500,000 per annum, based on MU's actual recovery of

F&A (which currently hovers at about 18%). As an aside, increasing total recovery of F&A has been extremely problematic for our institution, given our Another option would be to campaign for line-item compliance amounts in the budgets of sponsored activities. One problem is that this puts the fiscal burden for compliance largely on activities that enjoy extramural sponsorship. Finally, requests for federal "handouts" have often been discussed at meetings where compliance budget challenges are discussed.

A frequently-unappreciated portion of compliance costs consists of faculty and staff time. In fact, a recent study of IRB-related expenses[2] factored in what all administrators know is the most expensive aspect of faculty-populated committees: the professional time of those committee members who could be pursuing scholarship or interacting with students instead. Indeed, the issue of how much committee service is "too much" led most institutions to vest their IRBs with Health Insurance Portability and Accountability Act (HIPAA) compliance functions rather than to form a "privacy committee," which would have constituted one more entity requiring the input of faculty time. At MU, we are land-grant status and the fact that we conduct significant state-supported research where rates of "indirect" are much lower than the federal level. currently developing comprehensive business plans for human subjects protections, animal care-and-use, and other compliance activities so that we can provide an accurate assessment of actual costs involved. Because we are dealing with a capped situation, even seemingly innocuous suggestions can have adverse fiscal consequences. As an example, a UM System committee recently required that all IRB records related to "medically invasive research" be archived for a period of ten years after research subjects reach age 21. Thus, for research involving newborns, the archival period could be up to 31 years. The fact is that there are no funds in our IRBs' budgets to support this storage of records, even in electronic format, for this lengthy period of time.

Fielding an effective compliance effort is obviously one of the major costs associated with running an ambitious institutional research program. The reality that most compliance upgrades have come only after catastrophic problems should not deter research officers from working aggressively to ensure that appropriate resources are allocated to compliance oversight in all areas. Public policy demands no less.

[2] American Health Consultants. 2005. IRB costs are greater than previous estimates. IRB Advisor 5:77-78 (July).

Center for Economic Development, Innovation, and Commercialization: A Pathway for Economic Sustainability from Research and Application to Enterprise

Ron Kessler and Pike Powers

Introduction

Robert Barnhill

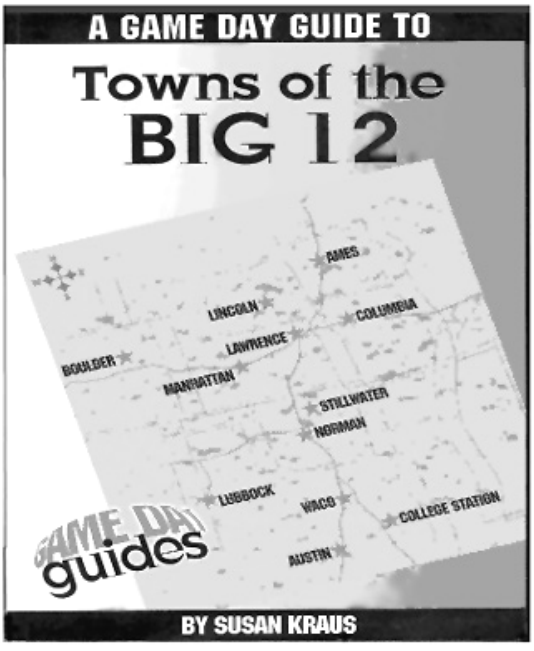
Vice Chancellor for Research and Technology Transfer, University of Texas System
Board member, Merrill Advanced Studies Center

Each year, participants in the Merrill Center Research Policy seminars have taken up a timely topic, this year's being "The Interface of Science and Public Policy." There are new national and international trends in science, some of which Alan Leshner has already covered, such as an increase in "big" science and in the sense of larger problems being addressed by teams of people. Such problems require multidisciplinary approaches as well as new kinds of leadership.

From the beginning, these Merrill Center conferences have brought together the university leadership from what I have called the "Midwestern four-corner" states of Kansas, Missouri, Iowa, and Nebraska. (Both as the senior research officer, formerly, at The University of Kansas and as a Lawrence, Kansas, native, I have enjoyed seeing five of the Big 7-–or Big 8—work together.) Many research and research policy collaborations have begun, both directly and indirectly, as a result of these meetings.

Now we are ready to consider a next geographical step for research and its societal utility to encompass the Big 12 conference. The Big 12 extends over seven states in the heartland of the nation; the communities have some commonalities, such as water sources and geography, and some differences, such as populations and growth patterns.

Texas generally and Austin in particular have the well deserved



reputations of encouraging economic encouraged various countermeasures. One was the formation of Sematech in Austin, which helped turn that particular tide. Among the key architects of this novel development were Pike Powers and Ron Kessler. Pike and Ron are now proposing to bring the ideas of the "Austin miracle" to the Big 12 universities and their communities.

They find inspiration in the statement of Irving Wladawsky-Berger, of IBM: "This emerging era is characterized by the collaborative innovation of many people working in gifted communities, just as innovation in the industrial era was characterized by individual genius."[1]

At the 2001 Merrill Center meeting on "Evaluating Research Productivity" I paraphrased the theme from *Competing for the Future* as: "Strategic intent by top leadership, coupled with natural advantages and local expertise, can lead to research enhancement that lifts the entire institution."[2] I cited this in the context of several universities who have so moved forward. Now let us consider multiple universities.

I like to paraphrase the title of the book *Only the Paranoid Survive*, by Andy Grove of Intel, as "only the flexible thrive." The latter is directly applicable to the Big 12 possibilities envisioned by Powers and Kessler. They suggest that we adopt a flexible approach to multi-institutional sharing and collaboration the areas of research and its societal impact. Their description of this project follows.

[1] Dr. Irving Wladawsky-Berger, vice president for technology & strategy at IBM, quoted in *The World is Flat*, Thomas L. Friedman, p. 93.

[2] Gary Hamel and C. K. Prahalad, *Competing for the Future*, p. 29.

Center for Economic Development, Innovation, and Commercialization

By Ron Kessler and Pike Powers

The purpose of the Big 12 Center for Economic Development, Innovation, and Commercialization (CEDIC) is to develop, foster, and nurture more collaborative and mutually beneficial activities within and among the 12 universities, and to facilitate the flow of innovation, commercialization, entrepreneurship, and "know-how" from the universities to the private sector, thereby creating jobs and enhancing the well-being of the citizens of each university's state and region. As a result, the collective assets and resources of the 12 university, seven-state region are effectively leveraged in ways and with benefits that no one university can achieve.

Intending to accelerate economic growth and intellectual excellence through collaboration, the Big 12 CEDIC has already created momentum and important support. The 12 universities individually and their seven home states have benefited significantly from collaborating in the Big 12 Conference. This athletic success will be extended and enhanced by addressing the significant issues facing each state and university through the Big 12 CEDIC.

Our approach involves five areas: collaboration, competition, celebration, communication, and capital.

- ***Collaboration*** will involve both joint Research to address common problems and coordinated Commercialization efforts to take university developed technologies to market.
- ***Competition*** will include both graduate and undergraduate student competitions to address common problems and provide experiential learning.
- ***Celebration*** will recognize, publicize and celebrate our outstanding business leaders, researchers and faculty.
- ***Communication*** will involve a coordinated media and publicity plan to communicate the activities, successes and excitement of the Big 12 CEDIC. This area also includes grant writing activity and corporate sponsor solicitation.
- ***Capital*** will involve the creation of university affinity funds and a Big 12 Fund of Funds and bringing together VC's and other capital providers.

Initiatives in each of these five areas will begin on October 1, 2005, and longer term initiatives will be launched over the next six months. After meeting and developing relationships with KTEC, the Kauffman Foundation, the Kansas City Federal Reserve Bank, Department of Commerce (EDA), RUPRI, LCRA, SBC, SAIC, IBM and various Chambers of

Commerce, we are ready to launch the Big 12 CEDIC.

We have found significant interest among the private, foundation, and government sectors and from economic development entities for this innovative approach. Potential corporate sponsors, venture capitalists, and other capital providers realize that they will be introduced to the best that these universities, individually and collectively, have to offer—the most innovative ideas, the finest and best prepared students, attractive host communities and a collaborative environment. Equally important, we have also received enthusiastic responses from Big 12 Vice Provosts for Research (VPR), Deans, and faculty members. As a result, meetings of VPRs and Engineering Deans are the first planned.

We have asked the school presidents and/or chancellors to sign a Big 12 CEDIC Charter to acknowledge their commitment to our seven-state region and to commit their universities to addressing the economic needs of the region and collaborating on increasing funding for research. This innovative concept has significant power. It will attract attention and increased research dollars, as well as position the Big 12 in an even more favorable light and in a national leadership position. Collectively, the 12 universities will create more opportunities for excellence than any one university acting alone.

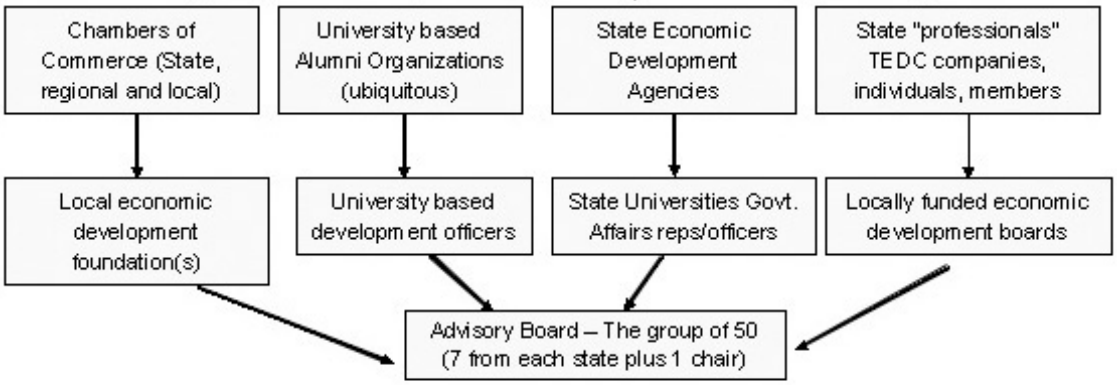
We will collaborate outside the universities to leverage the various economic development, workforce training, and capital providers for a focused seven-state regional economic development network.

The universities of the Big 12 have a tremendous opportunity to move beyond their past successes and to fulfill the significant role that the university plays in today's economy. This Big 12 collaboration serves to take these universities to a new level of excellence with increased prospects for additional funding sources and contributions to regional and local economies. Over the next decade the Big 12 universities will build capacity that leverages their unique assets, collaborate with other universities, and achieve an alignment with each university's mission of instruction, research and outreach. Maximum potential for good for society occurs at the intersection of the university, the private sector, the foundation sector, and the government sector as each looks for strategic alliances that improve the quality of life for the people of their region and state. No other athletic conference has attempted such a collaboration. The Big 12 doing it first and doing it well will set the "gold standard" for athletic conferences, economic development, innovation, and commercialization.

UNIVERSITY x 12 + STATE x 7 x COLLABORATION = "LEVERAGES"

Economic development – *blocking and tackling* - must have many sources of funding to create a focused common ground:

CAPCO(s) or similar ventures
VC Funds
Tech Transfer
Work Force Training



Brought together by common ground and the love of sports.

Creates BIG 12 "Network of Networks"
for a focused seven-state regional economic development network
convened in Fall to brief on first six programs;
Provides local muscle in public launch shortly thereafter.

Most of the world's really smart people aren't members of any single team but are distributed all over the place in multiple institutions. Similarly , we are now looking for innovations in the interstices between different disciplines—for example, between bio- and nanotechnologies. —**John Seely Brown**

Research and Engagement Opportunities for Applying Science to Public Policy

Alan J. Tomkins
Director, Public Policy Center
University of Nebraska

In 1997, a task force of faculty and administrators from across the five campuses of the University of Nebraska determined that NU "should do more to make public policy expertise and resources available to Nebraskans" and recommended the creation of a university-wide policy center to assist Nebraska's policymakers ("Recommendations for a University-Wide Public Policy Center," July 1, 1997). In January 1998, the University's Board of Regents formally established the Public Policy Center (PPC) as a unit to assist policymakers on a wide range of public policy issues.

The University of Nebraska Public Policy Center (http://ppc.nebraska.edu/) functions as an outreach and engagement unit of the University that serves the state and communities in Nebraska, as well as the nation, by providing information to policymakers that allows them to make better strategic decisions about policy options. The center conducts original research as well as mining information from the existing literature. In addition to directly assisting policymakers, the Center also serves a brokering function, that links policymakers with the vast expertise that exists at a large, public (and in this case, land-grant) university.

The University of Nebraska Public Policy Center in Action

The Center has operated as a generalist unit. In other words, we have not focused only on topical areas such as behavioral health services, fairness in the justice system, or health and human services information technology (all three of which are current areas of focus). Rather, we have worked on a diverse array of issues, including business/economics/taxes, persons with disabilities, education, food and society, governmental administration, natural resources, and rural community and economic development (see http://ppc.unl.edu/program_areas/by_category.html). We are actively engaged in 15-20 projects (not including brokered projects that are being conducted by other NU faculty and staff). The Center employs about 40 people (half students) and has a budget of approximately $3 million (approximately $175,000 is an appropriation from the University, the rest comes from external grants and contracts). We are a unique policy center among those across the nation in that we purposely serve all three branches of government. The

advisory board is composed of the Governor, the Chair of the Legislature's Executive Board, the State Court Administrator, and the provosts from each of the five NU campuses.

Over the years, the Public Policy Center has created a bridge between the university community and policymakers. Policymakers are inundated with information. A major challenge is to make sure that the data we believe policymakers should rely on are, in fact, considered by the policymaker. One way to do that is to make sure policymakers know and trust the source, so that they are receptive to the content of the message. The Public Policy Center tries to establish relationships with policymakers so that we can encourage them to seriously consider scientific information along with other considerations that are taken into account when complex policy choices are made. We have personal relationships with leadership from state agencies, Congressional offices, local officials, and other key individuals. Of course, more than relationships, the key to creating a successful bridge between the University and policymakers is to provide information that is based in evidence and is easy to use by policymakers. We recognize, however, that good information alone is insufficient to ensure that it will get to and be utilized by policymakers.

Another challenge involves science itself. Scientists disagree on the meaning or weight of scientific evidence, the nuances of such information, and so on. Simply because one scientist or Center advocates a position does not mean that a policymaker will necessarily follow the advice, nor should they. As the saying goes, "One scientist's gold is another's junk." Moreover, we scientists change our minds about information, which is a strength of the scientific enterprise but can be confusing for policymakers who must make a point-in-time judgment. For example, a recent analysis by Dr. Ioannidis of biomedical clinical studies originally published in highly regarded medical journals between 1990-2003 and cited by others more than 1,000 times, found that nearly 1/3 of the studies were either contradicted or modified by subsequent studies (John P. A. Ioannidis, "Contradicted and Initially Stronger Effects in Highly Cited Clinical Research," Journal of the American Medical Association, 294:218-228 [2005]). It is important to be clear about the fact that science is a dynamic, not static, enterprise, and it is also important to be prepared to help a policymaker deal with the fact of changing scientific evidence.

Although it is true that there are changes to scientific evidence even within short periods of time, as well as other limits to scientific information (imperfect methodologies, inadequately framed questions, difficulties in accessing appropriate samples, etc.), it is nonetheless a highly valuable tool to shape policy. Academia has a special role to play in ensuring that quality scientific information is presented understandably and effectively to policymakers. It is in this realm that the Public Policy Center has operated. We have capitalized on the opportunity and interest to provide academic information to policymakers.

There have been several instances in which the Public Policy Center has had major impacts on policy decisions in the state of Nebraska. Four examples are

presented here. The impacts the Center has had on national policies and practices will not be dealt with because of space considerations.

Selected Projects: Making a Difference in Nebraska

I. Child Support Payments & Disbursements

One of the first major projects on which the Public Policy Center worked was the Nebraska Child Support Collection and Disbursement System Implementation Project. In 1996, the U.S. Congress passed thee welfare reform bill, Personal Responsibility and Work Opportunities Reconciliation Act (PRWORA). At the last moment, state child support enforcement activities administered under Title IV-D of the Social Security Act were targeted, and states were required to establish a central unit for receipt and disbursement of child support.

At the time, the system was not doing its job of making sure that children were being financially supported by non-custodial parents. For example, as of 1989, 62% of custodial parents in the United States did not receive the child support their children were due, according to a 1994 Urban Institute report (Teresa A. Myers, "State Child Support Programs: Necessity Inspires Ingenuity," National Conference of State Legislatures State Legislative Report, 23(20), November 1998; available from http://www.ncsl.org/programs/cyf/csslr.htm). Centralization seemed like a reasonable response to remedy some of the deficiencies of the system. Title IV of PRWORA was designed to increase collection of child support dollars from non-custodial parents and to improve enforcement of child support orders through streamlined child support collections, increase paternity establishments and child support orders, strengthen penalties for delinquent payments, and provide incentives for payment of child support orders.

In response to the federal mandate, in 1997 the Nebraska Legislature began to grapple with the issue of centralization. Initial discussions made it clear there would not be a change without a political struggle. In general, there was satisfaction with the current child support collection and disbursement system, along with concerns about a federally mandated program that was believed not to be suited to the needs of Nebraskans. An anecdote, recounted frequently, told about the time a single mother went to a district court clerk on Christmas Eve to check whether her child support payment had been finally sent as promised by her ex-husband. Although illegal, the sympathetic clerk gave the single mother her payment, and the family's Christmas was saved. This was the type of service that would be eliminated in an impersonal, centralized receipt/disbursement system. A Governor's Child Support Collection Task Force concluded that through the creation of a State Disbursement Unit (SDU), the customer service provided by district court clerks would be lost.

Customer service might be lost, but so too would federal funding to the state to run its child support system if it failed to introduce a centralized system by October 1, 1999. The loss of funds would be in excess of $70 million. In June 1999, the Public Policy Center was asked by the Speaker and Executive Board of the

Nebraska Legislature to help figure out how Nebraska might preserve existing strengths and reduce or eliminate weakness in its child support customer service system, while complying with the federal mandate to develop a SDU. We needed to complete the effort by the end of the summer.

The Center invested all its resources into conducting the child support research and engagement project. Relevant laws were examined and policies analyzed. A Policy Center graduate assistant examined the academic business literature regarding best practices for customer service for guidance and ideas. In addition, senior staff researched stakeholder consensus techniques. A stakeholder engagement procedure was suggested to and adopted by the policy partners. The partners included key representatives from the legislature, the Governor's office, the Court Administrator's office, the Court Clerk's association, and so on. The Policy Center used public participatory techniques to get input from state stakeholders (e.g., judges, prosecuting and defense attorneys, custodial and non-custodial parents, large and small business employers, etc.). At the same time, Center staff members consulted with experts, staff, and officials from outside Nebraska. From these various sources, the Center identified options along with some specific recommendations (http://ppc.nebraska.edu/publications/documents/child_support_report.pdf). Ultimately, a large set of stakeholders agreed on the directions that should be taken to move to a centralized system. The legislature unanimously passed a bill to allow the state to move to a centralized system for receiving and dispersing support payments. The Center's background information and stakeholder facilitation and engagement helped craft and design the current system of child support payments that continues today. Nebraska lost no federal money.

II. Minority & Justice

The Nebraska Supreme Court and the Nebraska State Bar Association established the Minority and Justice Task Force (MJTF) in 2001. Its purpose was to identify actual or perceived racial and ethnic bias and discrimination in the Nebraska justice system and make recommendations to the Supreme Court on how to address these inequities. The MJTF's wide purview included issues such as potential bias in criminal prosecution, sentencing, court personnel hiring, law school admissions, and other related issues over four comprehensive areas of the system of justice: access to the courts, personnel and employment practices in the courts, the legal profession in the state of Nebraska, and criminal and juvenile court processes.

The Public Policy Center was brought in to a) oversee the research that was needed to identify and document problems, b) bring in academic resources to contribute to the MJTF (e.g., faculty and students from criminal justice, history, law, political science, psychology, sociology, etc.), and c) coordinate and administer the MJTF itself. Thus, the Center found itself at the center of a legal community-academic community alliance examining how best to address inequalities and prioritize and implement changes needed to the system.

One of the first important issues that the MJTF analyzed was representation on juries. We learned minorities lamented that jurors did not "look like them." Several factors were identified that contributed to the exclusion of racial and ethnic minority participation on juries, including how jury pool lists are compiled, juror qualification guidelines, counties that have not periodically updated their jury pool lists, and payment for jury service. Ultimately, changes were made to the state's statutes requiring regular updating of jury pool lists and allowing for collection of demographic data to monitor whether minorities are being summoned to serve on jury pools at a rate consistent with their numbers in the community.

The Supreme Court and State Bar Association established an on-going Implementation Committee (MJIC) to follow the Task Force. The Public Policy Center continues to be the key research partner and continues to administer the project as part of a state-bar-university partnership. Approximately a dozen state supreme courts have undertaken similar projects approaching this scale, but Nebraska now stands as one of the premier leaders in the nation for minority justice reform. (The Minority and Justice Force Final Report is available from http://ppc.nebraska.edu/publications/documents/mjtf_final_report.pdf, and the Progress Report for the Implementation Committee is available from http://ppc.nebraska.edu/program_areas/documents/mjtf/2004%20Progress%20Report.pdf.)

III. Behavioral Health

The Public Policy Center has been working closely with the state on improving and reforming its mental health and substance abuse service systems. The Center initiated a partnership among the Behavioral Health Division of the Nebraska Department of Health and Human Services, Interchurch Ministries of Nebraska, behavioral health providers, and consumer advocacy groups that resulted in a federal grant application in 2002 to the Compassion Capital Fund (U.S. Department of Health and Human Services, Administration of Children and Families) to fund an effort called Nebraskans Expanding Behavioral Health Access through Networking Delivery Systems (NEBHANDS http://www.nebhands.nebraska.edu).

NEBHANDS–-through the $3.3 million, three-year grant award--provides technical assistance, resources, and a forum for statewide collaboration and policy development, with the goal of creating accessible behavioral healthcare for underserved and poorly served Nebraskans by integrating faith-based and community-based organizations into the state's service system. In particular, the people we are trying to reach are African-Americans, Sudanese, Vietnamese, other ethnic minority groups, lower income individuals and families, and rural residents who are underserved or not being effectively served by our current mental health system.

We were one of 21 faith-based initiatives funded through the Bush Administration's controversial faith-based initiative. NEBHANDS has worked with over 100 organizations across the state, and it has involved thousands of providers, consumers, families, and policymakers. Promising networks of care have been created in a

predominantly African-American, North Omaha area, and in a seven-county area in south-central Nebraska where the focus is on early childhood mental health.

Our interests in improving the state's behavioral health system have led the Public Policy Center to become involved in working with the state's infrastructure to respond to disasters (www.disastermh.nebraska.edu/). In May 2004, a tornado ripped through the small rural town of Hallam, Nebraska, population 330. The Center had already been working with the Nebraska Department of Health and Human Services to create an All-Hazards Disaster Behavioral Health Response and Recovery Plan for the State. This included fostering links between mental health and substance abuse resources and public health systems, healthcare networks, emergency management, faith-based organizations and first responder groups.

After the tornado touched down, the Public Policy Center put the framework of the Recovery Plan into practice. Center staff immediately lent aid to people in crisis and thereafter submitted, on behalf of the state, a Federal Emergency Management Agency Crisis Counseling Program (FEMA-CCP) application. For the first time in Nebraska's history, the state received a FEMA-CCP grant for crisis intervention and management. A year later, Nebraska received a no-cost extension for the FEMA-CCP grant from the federal government thanks to the diligent documentation of the continuing need for these services throughout the state. Some of the emotional issues re-emerged as Nebraska went into its 2005 tornado season and severe storm activity started once again.

Clergy throughout the area came to Hallam in 2004 to help many of the victims in their recovery. Center staff learned from first responders that clergy were as likely to be a problem as they were to be of help. As a consequence, the Public Policy Center and its partner, Interchurch Ministries of Nebraska, created and then implemented a "disaster pastor" program that certified clergy to be part of the first responder team during disaster situations.

IV. Water Sciences

The Water Resources Research Initiative at the University of Nebraska-Lincoln was discussed previously in a Merrill Advanced Study Center Report (Prem Paul, "Engaging Faculty in Leading Collaborative Research," Merrill Advanced Study Center Report: Riding the Momentum of Research: Leadership Challenges in Public Research Universities, 108 (2004); available at http://merrill.ku.edu/publications/2004whitepaper/P_Paul.html)). The PPC has joined that effort, working to develop rural community collaborations and to make available water scientists who can help communities identify options for compliance with the EPA's implementation of the Safe Water Drinking Act. The Act requires a decrease in the amount of arsenic in drinking water from 50 parts per billion to 10 parts per billion, effective Jan. 1, 2006. Congress passed the Act because of a concern that arsenic in drinking water results in severe health problems. More than 80 public water systems in Nebraska, primarily in small communities, are affected by the lower arsenic standard. Compliance with the

Safe Drinking Water Act will strain the resources of small Nebraska communities (costs are estimated by Nebraska Health and Human services to be over $120 million) and have an adverse impact on rural sustainability.

The Center's key role involved facilitation and coordination. Water scientists and others (e.g., rural sociologists, extension faculty) provided substantive expertise as part of the University effort. The Center and its partners convinced two communities in the same watershed to collaborate on the process. The argument was that any solution would benefit from two community expenditures/investments rather than each one going at it alone. In addition, the community decision-making process that the Center established for arsenic abatement issues also provided an excellent opportunity to simultaneously identify community and/or economic development possibilities for the two communities involved in the project. We wanted to see if we could turn the "lemon" of the federal mandate to reduce arsenic levels into the "lemonade" of exploring joint community opportunities. (See generally http://ppc.nebraska.edu/program_areas/documents/WaterProject.htm.)

The results are positive so far. The communities agreed on a common solution approach, and they are collaborating on economic development ideas. The targeted communities have also worked with a Rural Sociology class from UNL and senior level under-graduates from the Civil Engineering Department (capstone Design Class) research engineering options related to arsenic abatement options. An NGO partner, The Groundwater Foundation, is supplying additional educational expertise about water matters. Another entity, the Midwest Assistance Program, provides water related technical assistance in development and support. Nebraska's Public Radio station provided media expertise and coverage so that issues and approaches might inform other communities (see http://mynptv.org/ne_connects/water_quality/).

Conclusion

Since 1998, the University of Nebraska Public Policy Center has been enriching public policy efforts by facilitating, developing and making available objective research. Center faculty and staff have undertaken the investigation of public policy issues and topics of importance to Nebraskans by coordinating policy research, linking policymakers with experts throughout the University system, raising the visibility of public policy-related research activities, and facilitating access to public policy research and expertise. The Center links faculty expertise in academic areas to specific problems for the purpose of extending outreach, education, and services to policymakers. The Center capitalizes on the expertise of faculty, staff, and students at the University of Nebraska who are engaged in activities that have the potential for improved public policy formation. We also look for opportunities to partner with other state and national institutions that have an interest in public policy. The Center brings a proactive focus to identification and research on emerging policy issues and establishing networks among researchers, educators, and policymakers.

Public Policy and Federal Investment in Basic Research in the Behavioral and Social Sciences

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Federal funding for basic research in the behavioral and social sciences (BSS) lags significantly behind funding for research in the natural, physical, and medical sciences. In 2003, for example, the National Institutes of Health awarded $936.1 million for basic BSS research, which represented roughly 35% of the total BSS research dollars ($2,684 million) and only 3.6% of the total NIH award budget ($26,354.2 million) for that year. Across the 25 NIH Institutes and Centers, the percentage of funds for basic BSS research varied widely, with the majority allocating less than 2% and only three awarding 10% or more of their funds to basic BSS projects.

These figures appeared in the 2004 Report of the Working Group of the NIH Advisory Committee to the Director on Research Opportunities in the Basic Behavioral and Social Sciences (http://obssr.od.nih.gov/activities/Basic%20Beh%20Report_complete.pdf). Other data in the report show that total federal research spending over the period 1993-2003 has been consistently lower in behavioral and social science fields than in life sciences, physical sciences, mathematics and computer sciences, and engineering fields.

The distinguished group of scientists on the panel made two recommendations to address these issues: 1) "A secure and stable home should be established at NIH that can serve to foster basic behavioral and social sciences research that is not closely linked to the missions of the categorical Institutes and Centers" and 2.) "The basic behavioral and social science research programs that are currently functioning well within ICs should continue in their present form" (p. 11). The first recommendation would designate an existing non-categorical NIH IC as the home for basic BSS proposals that do not fit within other ICS, with the panelists suggesting the National Institute of General Medical Sciences, National Institute on Aging, and National Institute of Child Health and Development as possible homes. The second would involve an enhancement of the funding and authority of the Office of Behavioral and Social Science Research. As reported in Science (10 December 2004), these recommendations "received a tepid reception … from NIH Director Elias Zerhouni" (p. 1878). Comments from NIGMS Director Jeremy Berg further into the article point out that

while some behavioral research might fit within NIGMS, "the social sciences would not be a natural fit," and ultimately any implementation of the recommendations would require reallocation of funds given the tight funding situation at NIH. Such reactions do not bode well for increasing the profile and funding of basic BSS research.

Administrative restructuring and a change in policy at the National Institute of Mental Health also promise to have negative effects on basic BSS research. NIMH was one of the institutes that provided a home for basic BSS research, with 8.1% of its funding awarded to basic BSS research in 2003. In October 2004, however, NIMH Director Thomas Insel announced an increased emphasis on translational research and a decreased emphasis on basic research, especially in the social sciences (*Science*, 22 October 2004). As stated on the NIMH web site, "We have shifted several areas of basic science, such as studies of emotional regulation or cognitive development, to new translational divisions to accelerate the development of tools to help patients. To work toward a long-term goal of personalized care, we are establishing new programs focusing on translating basic research into intervention development. Several current high priority areas, such as genetics and molecular, cellular, and behavioral neuroscience, will remain high priority areas. At the other end of the research spectrum, the Institute will continue to invest in practical clinical trials and services research. A key aspect of our reorganization is ensuring translation of the best ideas between divisions" (http://www.nimh.nih.gov/strategic/strategicplanmenu.cfm). *Science* (22 October 2004) identified several other areas affected by this shift, including research on personality, social psychology, theoretical modeling, and language. Implementing this shift not only involved restructuring the divisions within NIMH and setting guidelines for future applications, but also reassigning some current awards to other NIH Institutes and Centers.

Clearly, public policy as set by those within the National Institutes of Health in particular, and the federal government in general, has an influence on future progress in basic BSS research. Why should we care about the challenges to funding basic BSS research? Because the insights gained from such research are essential to a full understanding of the scientific challenges we face today. Consider Alzheimer's dementia as an example of one of those challenges. While developing drugs to cure or slow the progress of AD is absolutely essential, it is equally important to investigate strategies to help individuals with AD, their families, and their caregivers cope with the consequences of living with the disease. The latter topic is the province of social and behavioral scientists. Further, just as drug development begins with basic research at the cellular level, identification of coping strategies begins with basic research into language processing in AD, identity maintenance, marital satisfaction, memory, etc., that can be used to build effective interventions. Thus the translational research desired by NIMH depends upon the knowledge gained from basic research. To the extent that the institute no longer supports such basic research,

the foundation for translational research will be weakened.

Basic BSS research can also play an important role in informing research in the medical sciences, physical, and natural sciences. Again, AD research provides a compelling example. Susan Kemper, Roy A. Roberts Distinguished Professor of Psychology at The University of Kansas, has a long history of NIH/National Institute on Aging funding for basic research into language processing in aging. Her research into the characteristics of language processing in normal aging provided the foundation not only for research on language processing in those with dementia (e.g., Kemper, 1997; Kemper, Thompson, & Marquis, 2001), but also provided insights into the etiology of AD through her work on the Nun Study (Mitzner & Kemper, 2003; Snowdon, Kemper, Mortimer, Greiner, Wekstein, & Markesbery, 1996). Kemper analyzed the grammatical complexity and propositional content of writing samples that the nuns had completed in early and late adulthood. That analysis revealed that there were marked differences in the linguistic ability of the women early in life that were predictive of the development of AD in later life.

Basic BSS research, then, is a necessary precursor to translational research and an important partner in many investigations of interest to the medical, natural, and physical sciences. Similar arguments, however, were advanced in the Report of the Working Group of the NIH Advisory Committee to the Director on Research Opportunities in the Basic Behavioral and Social Sciences (http://obssr.od.nih.gov/activities/Basic%20Beh%20Report_complete.pdf). As the official reaction to the report shows, the validity of these arguments may be acknowledged, but that acknowledgment may not result in structural and priority changes at federal funding agencies, perhaps due to financial and/or political constraints. As research administrators, we are concerned with promoting funding opportunities for basic researchers in all disciplines, including the behavioral and social sciences. Therefore we must consider ways that we can help our basic BSS researchers to be successful in this funding climate. Certainly lending our support to recommendations such as those offered by the NIH Advisory Committee is one way, but there are three additional strategies that can offer more immediate, direct benefits to behavioral and social science researchers on our campuses: (1) build interdisciplinary research programs, (2) develop faculty mentoring programs targeted at BSS researchers, and (3) ensure that basic BSS research is included in materials featuring campus research.

Interdisciplinary research programs bring the complementary perspectives of scholars from different disciplines to bear on a common area of study. At The University of Kansas, for example, support for interdisciplinary research is formalized and rewarded through a system of designated research centers (Roberts, 2004). One of those centers, the Schiefelbusch Institute for Life Span Studies (LSI), has been particularly successful in providing an environment that fosters the success of basic BSS researchers (Warren, 2004). The means to achieving these successes are various,

ranging from enabling basic and applied BSS researchers to work together, to fostering collaborations between basic BSS researchers and those in the biosciences. As a Life Span Institute faculty affiliate and a basic BSS researcher myself, I have seen firsthand the importance of the interdisciplinary dialogue and infrastructure within LSI to the ability of basic BSS researchers to formulate competitive, scientifically sound research proposals to federal agencies.

Not all basic BSS researchers, however, will find a home for their research interests within an interdisciplinary center, even though their research productivity would be greatly enhanced with external funding. Research administration can assist those faculty by working with academic schools and departments to develop effective mentoring programs for junior faculty. For instance, administrators might organize workshops in which experienced, basic BSS researchers share their knowledge about writing competitive grant proposals, how to address the criteria in requests for proposals in the rationale for their projects, how to articulate the importance of the basic research proposed to the development of effective interventions/treatments, etc. A related approach might involve faculty who have served on federal review panels for BSS research explaining the review process. In a more intensive process, experienced investigators could work closely with new investigators in the same area of study, providing feedback and guidance during the proposal preparation process. The goal of such mentoring programs would be to provide a foundation for the success of junior faculty in the increasingly competitive federal funding arena. Note that the success of mentoring requires the buy-in of senior faculty members who are seasoned investigators. Proposal preparation staff within research administration units can assist faculty with the technical aspects of application forms, but they cannot be expected to provide the feedback on the quality of the scientific argument. Senior faculty must be the source of such feedback. These individuals are best able to help junior faculty to appreciate the requirements for a successful proposal because they understand the scientific issues involved and the strategies for communicating those issues to review committees.

The third strategy that we can adopt is to ensure that reports of university research successes include examples of funded basic BSS research. This will serve important functions. First, it will communicate to students and faculty that basic research in the behavioral and social sciences is valuable and valued. Communicating this message is critical to maintaining the morale of basic BSS researchers and providing an incentive for adding to BSS successes in the future. Second, it will help to broaden external audiences' conceptions of "research" and "science" beyond the natural, physical, and medical sciences. One outcome might be opening a dialogue on research agendas with policy makers that can include basic BSS research.

The data show that basic BSS research faces funding challenges, even though evidence of its importance to a full understanding of the scientific challenges of the 21st century is abundant.

Advocating for policy change within funding agencies should be continued. In addition, the basic BSS researchers on our campuses stand to benefit from our adopting the three "local" strategies outlined here. They would not be the sole beneficiaries, however, for the on-campus culture created by these strategies would improve the research climate for those in all disciplines.

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When Science and Politics Collide

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Science, at its essence, is the force inherent in our nature to better understand the world around us. The thirst to know more, to discover new knowledge, and to improve the quality of life are innate human characteristics, and yet science is also perceived by some as a threat. Throughout history, those who have sought the advancement of science to improve the human condition have often found others constructing speed bumps to progress, and some have succeeded in significantly slowing its pace. And so it is again today, as science and politics collide over issues surrounding stem cell research and therapeutic cloning.

As a physician, an educator, a researcher, and a leader in the health care community, I believe it is my responsibility and the responsibility of all scientists and educators to be a resource, both to the public and to lawmakers who have a responsibility to decide crucial issues such as this.

For that reason, I testified in March 2005 before the Kansas House Federal and State Affairs Committee against House Bill 2355. The critical problem that I and many others see with HB 2355 is that, while it aims to outlaw human cloning, the specific language of the bill does so at the expense of criminalizing the exploration of an entire category of research that holds the potential to profoundly ease human suffering--research that will allow us to study the molecular basis of diseases as they develop from conception to death. This research holds the promise of discovering treatments and cures for such chronic diseases as Parkinson's, juvenile diabetes, ALS, heart disease, cancer, spinal cord injuries and Alzheimer's disease.

Between April and October 2005, I gave 50 talks on the science of stem cell research to citizens throughout the state of Kansas. I also recently conducted a series of seminars with Kansas legislators called Stem Cell Research 101 to educate them on the science and ethical considerations of this work.

Much of the controversy and misunderstanding about stem cell research centers on use of the emotional and highly-charged word "cloning." When most of us hear this word out of context, we tend to think of the process of creating genetically identical human beings—human reproductive cloning—a terrifying prospect to be sure.

In fact, there is another type of cloning, called "therapeutic cloning," that seeks to create a line of stem cells genetically identical to the originating cell

for use in research and treatment. One of the most promising forms of therapeutic cloning is called "somatic cell nuclear transfer" or SCNT for short. SCNT is the transplanting of a patient's DNA into an unfertilized egg in order to grow stem cells that could replace organs or tissue in order to cure diseases. They could also be used to discover new drugs for the treatment of patients.

SCNT is not meant to create new life; it literally extends life. SCNT works with the cells of an already-living person to create an environment where these cells can multiply to produce stem cells. These stem cells can then replace damaged cells in the body, such as bone marrow for leukemia and chemotherapy patients, nerve cells for Parkinson's and Alzheimer's disease patients, heart muscle cells for diseased hearts, and pancreatic islet cells for diabetic patients.

SCNT is also essential to help scientists understand how stem cells and other cells develop. This includes understanding how cancer cells grow and develop, which is essential for ultimately finding a cure for cancer.

The goal of therapeutic cloning or SCNT is not to produce babies. There is no fertilization of the egg by sperm, no implantation in the uterus and no pregnancy. The goal is to produce cells. SCNT's aim is to treat or cure patients by creating tailor-made, genetically identical stem cells that the patient's body will not reject after transplantation. SCNT could allow patients to be cured using their own DNA and could result in significant breakthroughs just as the use of stem cells in bone marrow transplants is saving lives today. Unfortunately, SCNT could be criminalized under the provisions of HB 2355.

At The University of Kansas Medical Center we are very supportive of efforts to utilize adult stem cells (stem cells drawn from fetal cord blood or from other adult tissue sources) for biomedical research. However, adult stem cells and early stem cells are not replacements for one another. Because early stem cells are pluripotent--meaning they can become any cell in the body--they can be applied to a far greater variety of contexts than adult stem cells and can also be grown in a lab indefinitely. Consequently, pursuing both avenues provides the best hope for achieving dramatic progress in discovering new cures.

I would like to point out that there are other unintended consequences to criminalizing SCNT. The spirit of discovery that fuels scientific advancement in our society would be lost. In addition, Kansas patients may be deprived of the benefits of currently accepted treatments and the science behind those treatments. And patients – and perhaps physicians as well – may leave our medical centers and hospital to pursue the possibility of more innovative care provided in other states. If that occurs, there will be a direct economic impact and an indirect loss of additional business growth.

While the nation and our state are currently engaged in a robust discussion regarding the appropriate use of stem cell research, a large majority of Americans and Kansans believe such research has promise and should be pursued.

According to a WSJ/Harris Interactive Poll in June 2005, 74% of Americans think that stem cell research

should be allowed, 14% believe it should not be allowed and 12% are not sure.

According to similar polls conducted in Kansas and Missouri, 61% of Kansans and 56% of Missourians approve of stem cell research, while 21% and 24%, respectively, disapprove. When asked if they approve or disapprove of SCNT research, 71% of Kansans and Missourian said they approved.

During the last Missouri legislative session, an anti-stem cell research bill was argued for in the Senate by Republicans but shelved for lack of support. It is anticipated that the bill will be reintroduced in 2006. Some are considering whether to have a public referendum for a constitutional amendment during the November 2006 election.

In Kansas, an anti-human cloning bill was introduced in the House and 49 representatives signed on. Hearings and discussion followed by the House Federal and State Affairs Committee; the chair did not report the bill out of committee and sent it for intersession review. It is expected that the bill will be reintroduced.

In response to restrictions on stem cell research, many Americans have become involved in advocating for research. We have an active group of committed individuals in the Greater Kansas City Chamber of Commerce who have made this the Chamber's top legislative agenda item.

A campaign being conduced by the Kansas Coalition for Life Saving Cures will reach many Kansans and encourage them in turn to advocate for research to improve the quality of life for those suffering from debilitating disease. The educational effort that will be at the cornerstone of this campaign will have tremendous collateral benefits. It is our opportunity to teach new audiences, to build new coalitions, and to advance our mission of improving human health through research.

This is a time of vigilance. We cannot afford to be complacent or silent. All of us share an obligation to advance the search for truth. As the line between science and politics grows thinner, it is our responsibility to be a principled resource for our policymakers, for our public, and for those who may benefit from these scientific endeavors.

I understand and appreciate the deep moral and ethical considerations involved with this issue, but I remain convinced that laws that would prevent and criminalize the pursuit of research to discover life saving cures and treatments are inappropriate. I applaud efforts to outlaw human reproductive cloning, as do all reputable researchers, but I urge our lawmakers to advance the cause of research, education and healthcare by opposing legislation that limits the life-saving cures and treatments central to our shared mission and to the overall quality of life of Kansans.

Kansas has always been a state known for its sweeping horizons. It will be up to us to make Kansas a place that really is as big as you think.

Scales of Engagement, Challenges, and Opportunities in Linking Public Policy and Research

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At times, as we attempt to address and respond to the public relative to the challenges and opportunities linked to policy implications for university research, we lose sight of the importance of understanding scales of engagement in developing effective strategic research priorities. Global and national level policies and agendas at times drive priority research thrusts, yet state and local policy decision-makers and incentives, as well as the public at large, can strongly influence university research agendas and strategies and must not be minimized. Often, strategies that are sensitive to maximizing research potentials between global, national, state, and local policies and attitudes have the greatest potential to advance university research success and create sustainable development opportunities. This paper provides a brief overview of some of the science challenges we face and the context for adjusting to public policy implications at multiple scales, with particular examples framed within the context of Kansas State University.

The Global and National Scale

As Alan Leshner has pointed out (2003), science is an integral part of everyone's lives: "virtually every major issue facing our global society today has science and technology components at its core: terrorism and other forms of violence, economic productivity, health status, global warming, and the need for sustainable development." The international and national levels of policy response to these core issues have created research challenges and opportunities as scientists attempt to address these substantial research questions.

In part, the resulting challenges and opportunities for the research university relate to public perception and attitudes toward a particular science issue, and in part we are influenced—both good and bad—by international or national policies that incentivize or restrict research agendas. At various times, efforts by scientists to "enlighten" the public have only further divided the public on certain sensitive issues. Mad cow disease, genetically modified plants, human and reproductive rights, such as stem cell research and cloning, and creation theory linked to evolution and intelligent design, are just a few examples of issues challenging scientific research results relative to public views.

International and federal policies in response to long-term global change create other challenges for the research university. Global warming, for example, is gaining considerable debate, and international policies have evolved to address problems identified through scientific research. Yet despite the Kyoto Agreement and pressures by international partners, such as the G8, the United States government has not taken a conclusive position on global warming, and even some scientists who have researched the global warming phenomenon are now under scrutiny regarding the validity of those findings (Monastersky, 2005).

Post 9/11 federal policies related to immigration, debates related to renewal of the Higher Education Act, and strategic priorities related to major federal agencies have also had and will continue to have ongoing impact on university graduate programs and research. Real and perceived policies related to international graduate student access to American universities, for example, have had an impact on many major U.S. universities, and at least in the short-term have reduced what has often been perceived as a positive complementary infusion of a significant scientifically skilled graduate student international population.

The reauthorization of the Higher Education Policy Act could further increase federal performance expectations of universities receiving federal funding. Federal agency funding priorities are also changing as new strategic security research thrusts gain higher levels of congressional support.

National Policy Debates, State and Local Level Adjustments, and Kansas State University

As previously mentioned, the use of somatic cell nuclear transplantation versus other forms of stem cells (including matrix cells from the umbilical cord) draws considerable debate at the national as well as state levels, and has strong implications for scientific inquiry. At the federal level, only limited forms of stem cell research have access to federal research funds, and Kansas and other states have threatened to further regulate stem cell research and any link to cloning.

A team of scientists at Kansas State University (M. Weiss, D. Troyer and D. Davis), in partnership with a University of Kansas researcher (K. Mitchell), has done extensive research on umbilical cord matrix stem cells that are readily available and much less controversial than stem cells linked to somatic cell nuclear transplantation. These umbilical cord matrix cells exhibit characteristics of stem cells that have the capacity to self-renew and differentiate into multiple cell types. Efforts are underway at Kansas State University to establish a center for such stem cell research; the center's science advisory board will include representatives from The University of Kansas and KU Medical Center.

Genetically modified crops have also created some debate at various policy levels because of perceptions that such modifications are unwholesome and might contaminate existing crops. Such work has been done in part at K-State to improve plant resistance to either herbicides or insects. K-State's H. Trick's research and patent, for example, has

transgenically modified soybeans to create greater resistance to soybean cyst nematode. A significant portion of most planted varieties of soybeans have been transgenically modified and play an important role in this crop's long-term economic success in the United States.

Concerns about Mad Cow disease (BSE—bovine spongiform encephalopathy) have gained considerable attention—from state to national to international levels—and have fostered evolving policies linked to concerns about this disease. K-State agricultural economics researchers B. Coffey, J. Mintert, S. Fox, T. Schroeder, and L. Valentin have recently estimated (2005) that even as strong as the domestic beef industry is at present, Mad Cow issues and concerns in 2004 cost the U.S. between $3.2 and $4.7 billion. KSU is currently a USDA approved test site for BSE, although, to date, no animal has been tested.

Kansas Senate Bill 345, Performance Agreements, and Kansas State University Research

Coupled with passage of Kansas Senate Bill 345 in 1999 and some restructuring of Kansas Higher Education was a movement toward block grants for Kansas regents universities, tuition retention, evolving performance agreements from the Kansas Board of Regents, and incentives for looking anew at revenue sources and creative approaches to sustain and, where possible, enhance university success. At Kansas State University, state level funding as a proportion of our total appropriation has dropped from over 40% approximately ten years ago to approximately 27% in the most recently completed fiscal year. In response to this trend and Senate Bill 345 (in which K-State identified as one of its performance goals increased levels of research funding and alumni support) Kansas State University has been working aggressively to identify alternative financial resource areas that will allow the university to make continued progress on numerous fronts. One progress area includes creative ways to advance K-State's position as a premier land grant institution while enhancing our success in competitive extramural funding.

Two years ago K-State created the "Targeted Excellence" program that includes a $2 million per year investment for five years in selected areas that will advance K-State's stature and respond to overall national and global concerns. The Targeted Excellence program has a strong focus on interdisciplinary, integrative collaborations geared to exploiting and developing institutional strengths, with overarching national and global concerns for security and resource sustainability as factors of influence, collaborations, and emphases. Projects funded are focusing on themes that maximize outcomes potential through sensitivities to policies at multiple levels. Targeted Excellence projects selected at K-State were results of peer review by both on-campus and national-level panelists. Top awards have received up to $2 million total over five years.

An example of one project funded is in the area of food safety and security (C. Kastner as P.I.). This project grew out of activities of the KSU Food Science

Institute and the university's longstanding commitment and leadership to food safety. This project will also help strengthen K-State's position as a leader in bio-food security as the university completes its new $50 million BL3 agricultural building that will provide a forward-looking site for cutting-edge bio-food security related research.

Another Targeted Excellence funded project is focused on a more integrated approach to managing water resources, a critical resource issue not only in Kansas, but nationally and globally (D. Steward and S. Welch are P.I.'s). The research provides an integrated scientific support approach within the natural human system for water-use decisions at all scales; it involves faculty from engineering, the sciences, and social sciences across the university community.

We are also exploring ways to extend our Targeted Excellence and related research initiatives through such approaches as: (1) enhanced community--state partnerships, (2) enhanced links to the National Institute for Strategic Technology Acquisition and Commercialization (NISTAC), and (3) capitalizing on opportunities presented through the Kansas Bioscience Authority and related partnering with The University of Kansas and K.U. Medical Center. NISTAC, for example, which is a partnership between the state, local government, and Kansas State University, provides opportunities to extend our research discovery to commercialization ventures that enhance state and local economic development while the Kansas Bioscience Authority that came out of the 2004 legislative session provides K-State a unique opportunity to extend our expertise in the biosciences to new levels of success and state economic gain through special state investments. These are but a few ways in which we need to be more entrepreneurial as we respond to public policy at the federal, state, and local levels as we reinvent ourselves in new and positive ways.

Conclusion

Clearly this is a period of significant transition as universities respond to changing public policy at various scales of influence that extend from local to state to national levels and beyond. Our future success will, in part, be determined by how well we engage the public at all scales of operation as well as how effectively we create new approaches to enhance revenue streams to our university research enterprise within new public policy environments.

In the public policy arena we need to:

1. use concerned citizen groups to more effectively engage local communities and the public at large relative to the value of science;
2. ensure that there are more trained "science" journalists who can help communicate the scientific basis and opportunities associated with scientific discovery;
3. have a more coordinated effort at all levels (national, state and within universities) to popularize science;
4. better articulate the impact of science (both historically and now) on the quality of our lives, and

5. better understand the impact of scale and relationships better in different modes of operation – from local (including within universities) to state to national.

Simultaneously, we need to explore creative alternative revenue sources through new partnerships and ideas that allow research universities to continue to thrive as beacons of research discovery and engines for economic development. The time for such effort is now.

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The Science and Public Policy Interface: Subset of a Larger Problem

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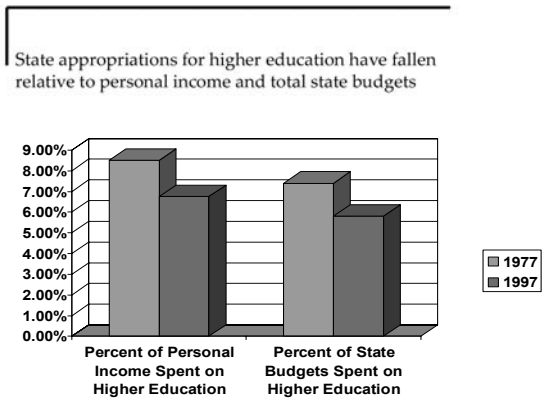
Higher education in the United States, particularly public higher education, is under considerable stress, a stress that affects every decision chancellors, presidents and provosts make, from faculty salaries to student tuition charges and library acquisitions. The stress comes from many sources but I believe much of it derives from the decision made implicitly in the legislative halls of every state, the decision that higher education is primarily a private good, not a public one. Private goods benefit the individual who receives them, while public goods benefit society at large. At least since the passage of the Morrill Act in 1862, the notion that higher education serves public ends has been widely accepted. But during the last thirty years, legislative opinion, as evidenced by legislative appropriations, has changed. We now appear to believe that higher education has such a private goods nature that it should be paid for primarily by those who receive it, the students, and to a smaller degree, by the public, which apparently is deemed to be only a minor beneficiary. Whether this change in judgment is justified by the ratio of private/public benefits derived from public higher education is not the focus of this paper; the focus is on the impact this judgment has had on the academy.

There are many consequences for this relative withdrawal of public support for higher education. Since the cost of providing higher education has increased while the public support was drawn down, a mad dash for replacement funding has ensued. Students, private donors, corporate donors, research foundations, etc., have become the new financers of higher education. As additional monies have come from these sources, so have additional demands and influences. Many of these demands have come from the U.S. government in the form of restrictions on the foci of research, but the U.S. government is hardly the only donor making demands on the academy.

I will review the financial situation of public four-year universities relative to that of private four-year institutions and then examine how that financial situation permits various donors to involve themselves in higher education's mission. With full credit to the authors, I will use both the data and format used by Thomas Kane and Peter Orszag in "State Support for Higher Education, Medicaid and the Business Cycle."[1]

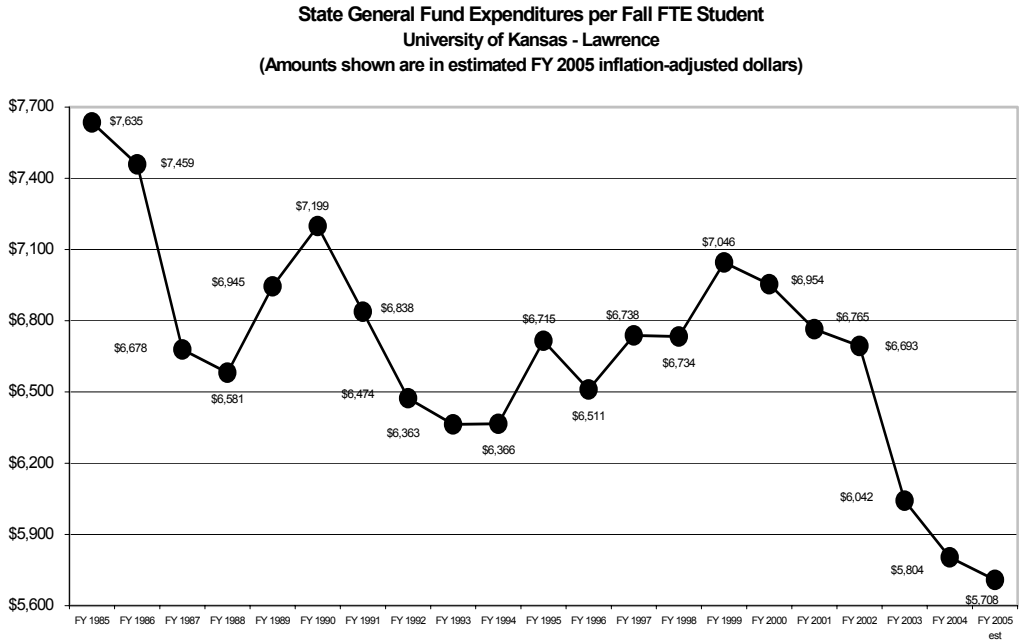
[1] Peter Orszag of the Brookings Institution, and Thomas Kane, UCLA, http://www.brook.edu/views/papers/orszag/20021011.htm

State legislatures have not appropriated funds to higher education proportional to the growth in personal income. In 1977, 8.5% of personal income was appropriated to support higher education. By 2003, this amount had fallen to under 7%.



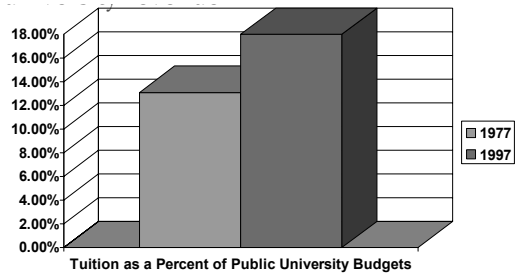
(Source for six bar graphs: Orszag and Kane)

The decline in expenditure relative to total state expenditure shows the same trend. In 1977, just under 7.5% of state budgets went to higher education; in 2001 this percentage had fallen to about 5.75%. In Kansas, as in the nation, higher education has been deemphasized as a recipient of state funding. The graph below shows the remarkable decline in the real state appropriation per student at The University of Kansas, Lawrence.



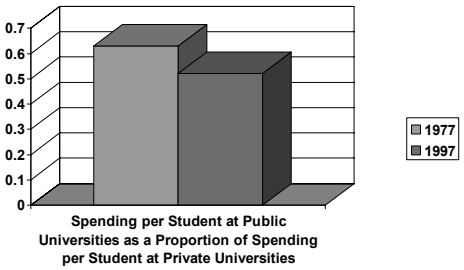
Public universities have responded by increasing tuition. Tuition as a proportion of funding grew from just over 13% of budgets in 1977 to over 18% in 1997. The state-funded portions of university budgets, my university included, comprise less than 25% of the total; universities like Colorado and Virginia receive less than 10% of their total budgets from their states. In FY'05, for the first time at The University of Kansas, Lawrence, tuition revenue exceeded state general fund appropriations, which fell to approximately 22% of total university revenue.

And tuition is a larger portion of public university revenue



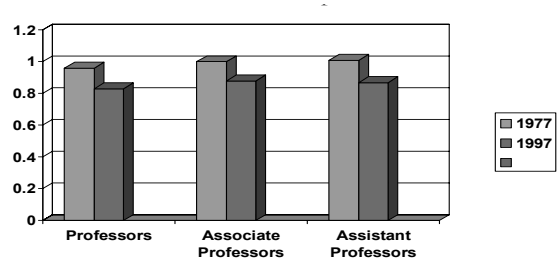
Private universities had no state support to lose. To compensate, they instituted tuition levels several times higher than their public counterparts and vigorously sought private endowments. Except for the occasional reversal in endowment levels caused by market fluctuations, this combination of endowment earnings and high tuition has given private universities a funding edge.

Spending per student at public institutions has not kept pace with that at private institutions



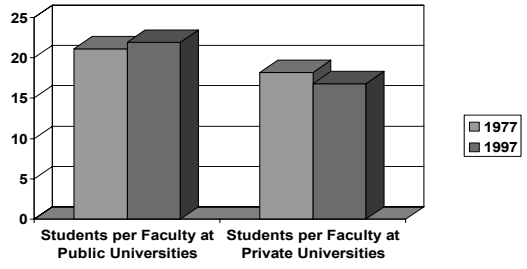
Kane and Orszag illustrate this advantage by examining the ratio of per student spending at private and public institutions. In 1977, public institutions spent 63% of what their private counterparts spent per student. By 1997 this amount had dropped to less than 55%.

Salaries for professors at public research universities have declined relative to those at private



The biggest portion of any educational institution's budget is made up of faculty salaries. Given the lower level of tuition and relatively smaller state appropriation, it should not surprise you that salaries at public institutions have declined relative to salaries at private ones. In 1977, full professor salaries at public institutions were close to parity with those at privates; salaries of assistant professors were slightly greater, and associate professors were paid exactly on par. By 1997, the situation for all three categories had worsened considerably. At public institutions, professors' pay was at 82% of private

Student/Faculty ratios at public institutions increased while at private institutions they decreased



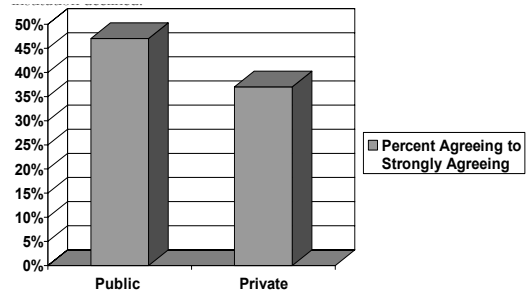
peers, associate professors were at 88%, and assistant professors were at 84%. Those differences are enough to cause those who are mobile to relocate and to lower morale for those who are not able to move.

Unfortunately, the reduction in relative salaries was accompanied by increases in teaching loads. In 1977, public universities had 21 to 1 ratios of students to faculty, compared to private universities with about 18 to 1 ratios. By 1997, the public institutions had risen to nearly 22 to 1 while ratios at private institutions had dropped to under 17 to 1. A difference of three more students per faculty member in 1977 increased to five more students per faculty in 20 years, an increase large enough to be noticed by faculty and students alike.

Over 20 years this differentiation in resources was accompanied by increased differentiation in the quality of entering students at public and private universities. On both verbal and math SAT scores, the private institutions widened their advantage over their public brethren.

Tenured Faculty Perceptions:

"In recent years, has the quality of undergraduate education at your institution declined?"



These student quality statistics are complemented by the perceptions of tenured faculty. Substantially more public than private faculty felt undergraduate education had declined in quality at their institutions.

Incoming student quality 1986 vs. 2000

source: Orszag and Kane

Among public and private institutions with similar students in 1986 public schools experienced a relative decline of:

- 12 to 13 points in Math SAT (75th percentile)
- 12 to 18 points in Math SAT (25th percentile)
- 16 to 23 points in Verbal SAT (75th percentile)
- 17 to 23 points in Verbal SAT (25th percentile)

The tuition increases that have been so much in the headlines are a defensive measure designed to keep the relative decline in the quality of public universities from growing worse. The stakes are high. As Kane and Orszag observe: "Since roughly three-quarters of college students are enrolled in public institutions implications could be substantial." "Substantial" indeed! The competitiveness of our country in science and industry may well rest in the balance.

When public institutions' historic patrons—state governments—withdraw support, those institutions either must choose to reduce their budgets or find other sources of funding. The former choice has severe, negative quality implications that are illustrated clearly by the previous data. The competition to public universities comes from private institutions. The decline in available funding per student already has had the apparent effect of relative quality reduction. In my judgment, the nation will be poorly served if we permit public

higher education to fall further behind in quality relative to the private sector. My public university colleagues apparently share this view, as they are all vigorously seeking funding from many sources to replace rapidly decreasing state monies.

If the State is paying a smaller proportion who is paying a larger proportion?

Financial support from other sources is increasing:
- Tuition
- Federal grants
- Big-time athletics
- Sale of intellectual property
- Private giving
- Exclusive commercial rights and "sponsorships"

This search for additional funding has been successful to various degrees. Invariably, success causes public universities to confront a universal maximum: "He who pays the piper calls the tune." Donors, sponsors, vendors, and other funders generally want something for the money they contribute.

The Tune Called by Public Funders

- Stem cell research limitations
- Intelligent design
- Reproductive-related teaching and research
- Chimera
- Political pressure in the class-room—National Academy of Scholars

Universities increasingly have sought federal funding for research; this began with the passage of the Morrill Act, accelerated through the Sputnik era, and went into orbit with the recent doubling of NIH funding. This growing dependence on federal sources has permitted individuals and groups with agendas to constrain what might be done with federal research funding or to define narrowly the criteria that determine which scholars may receive funding. Clearly, scientists and university administrators believe that some of these limitations affect the quality of science and restrict research to less productive areas. Some of the items on the list represent current constraints while others are areas in which there is agitation to impose constraints. Those who propose such constraints clearly believe that their efforts are justified on ethical grounds. I do not attempt to contest motives. I do note that it is the need for federal funds that increasingly leaves universities open to pressure from politicians with agendas that have no basis in science.

The federal government proposes a subset of constraints in the name of national security. At first glance, these do not appear to be limits on university research, but rather actions to promote safety. Indeed, some do have an impact on national security but they also have the impact of reducing the availability or quality of the inputs to the research process or the competitiveness of the venues in which research findings can be distributed. The effect of these constraints imposed in the name of national security result in research universities being far less competitive for funding.

National Security Tunes

- Admission of international students
- Constraints on export of technology
- Constraints on publishing
- Constraints on research personnel who conduct sensitive research
- Questionable classification of research by government agencies

Double-digit tuition increases have been the norm for public universities for the last several years. While the level of public tuition averages less than one-third that of private universities, the rate of increase, not the level, has captured the public's attention. Since public university tuition is established through a public process, students have political power. While this power may not have the effect of keeping tuition increases under double digits, it has had an impact on what the increased tuition "buys" for the students. The news is full of reports about luxury amenities popping up on university campuses around the nation, student and taxpayer outrage at the language proficiency of GTAs, and the steadily rising grades of college students. While no self-respecting university administrator would admit to "selling" such items in exchange for higher tuition, students seem to understand their newly acquired power to influence the "product" they receive.

Tuition Payer Tunes

- Recreation centers with big climbing walls
- Fewer international GTAs
- Grade inflation
- Liberal education vs careerism
- Apartment-like residence halls

Nearly all public research universities are engaged in big-time athletics. While few even pretend that athletics ticket revenues cover all expenses, all understand that reduced ticket sales or donations can make athletics more dependent on university funds. Many university administrators believe that athletic success opens political doors leading to increased general university funding and to donors who may support academic programs on top of their gifts to athletics. Some harbor the hope that athletic success will attract students and thereby provide needed tuition revenue. While there are empirical studies that cast doubt on the trickle down benefits that athletics provide to academic programs, big time athletic programs and supporters have access to those who make university decisions. Athletics thereby becomes another campus piper.

Athletic Tunes

- Luxury suites
- Strength centers
- Special admission consideration

Every university endowment fund-raising effort begins with a strategic examination of where donor gifts can make a real difference in the quality of the institution. This examination establishes goals and targets for the campaign. In the postmortem of every campaign, the realization dawns that many specific goals and targets were not met and many non-strategic items were funded instead. Sometimes mid-campaign corrections are necessary to mitigate the failure of initial strategic planning. Sometimes, however, gifts simply do not complement the strategic aims of the institution. Some such gifts end up being ultimately of greater value to the institution than the articulated priorities; many others do not. The various donor priorities may affect any of the categories that follow.

Donor Tunes

- Facility priorities
- Faculty support priorities
- Student support priorities
- Program support priorities

Finally, the commercial world intrudes into the academy. While we pride ourselves on being temples that tower above such concerns, a reading of the Bible tells us that commercial intrusions into "sacred" institutions have a very long history. The current debate is whether these business-education agreements corrupt the soul of the academy or merely provide funds with which it can better carry out its mission.

Commercial Tunes

- Drink my soda
- Wear my shoes

Fortunately, academic administrators are adaptable. When many diverse donors wish to call many diverse tunes, the capable administrator perhaps can fit these requests into the institution's mission so that a potential cacophony becomes a symphony.

This feat is not magic. For example, donors often specify that scholarships go to individuals from specific geographic areas while the institution may wish to provide scholarships to the neediest or most capable students. The scholarship administrator proceeds according to institutional goals and identifies the neediest/best students. Probably one or more of the students in this group come from the scholarship donor's designated geographic area. Those students get the donor's scholarships and scholarship funds without such restrictions go to other students. The final array of recipients is consistent with the institution's priorities and the donor's wishes are satisfied.

In a more controversial area, the government now prohibits federal funding of stem cell research unless the cells are derived from certain specified lines. Universities seek federal funding to do permitted research and reallocate private funding or institutional funds to do research on other stem cell lines. The federal restriction is satisfied while the institution's mission to perform cutting edge research into all areas is satisfied.

How to cope with all this diverse music?

Create a harmony; e.g.

- Use private funding to do stem cell research
- Use unrestricted funds to compensate for restrictions
- Use joint appointments with entities not constrained to avoid restrictions

Thus the clever university bureaucrat can dance to the donors' tunes without being unfaithful to the university's mission. Perhaps faculty and students view the resulting music as a masterpiece. But does this process have unwanted consequences?

Then, such restrictions do not matter?

Of course they do. Evasion of restrictions:

- Is ineffective
- Is corrosive of trust
- Invites even more intrusive regulation, e.g., criminalization of stem cell research

Yes, it does; harm is done. At a minimum, valuable administrative time is spent doing all the permutations

needed to satisfy donor demands. Far less effort would be required to produce the same ends if unrestricted funds were available. More menacing is that this process of accommodation corrodes trust. The donor looks at the institution and sees that the clever tune he or she intended to call has not affected the overall behavior of the institution very much or at all. This revelation hardly encourages more giving. Rather it encourages the donor to tighten restrictions even more so that there is an impact on the institution. Imagine a scholarship donor who requires that ten percent of all scholarship recipients come from geographic area "X" instead of requiring that his/her scholarship funds flow to recipients from "X." This restriction does impact the university's ability to carry out its mission.

Such donor restrictions can be eliminated by refusing to accept the funding if accepting causes more harm than doing without. Unfortunately, some donors have a coercive edge that arises from their legislative powers rather than from their purses. For example, Congress could prohibit by law all stem cell research. Such restrictions could not be evaded by clever bureaucrats and would cause real harm to science. Do attempts to circumvent restrictions simply enrage donors and cause them to seek more effective and destructive means to reach their ends? I fear so.

There is no substitute for understanding. Rather than using our brains to outwit those whose resources and power might enable them to restrict university activities, it would be far better if we could persuade them of the long-term good done by letting free inquiry characterize the academy. The larger society has been well served by academic freedom and this truth is evident all around us. We should not shy away from defending freedom of inquiry, but engage in the long, hard intellectual slog needed to defend it.

Long, hard slog to maintain or regain academic freedom

> ". . . freedom to think as you will and to speak as you think are means indispensable to the discovery and spread of political truth." –Justice Louis D. Brandeis, Larkin vs. State of California, 1927

The challenges to preserve intellectual freedom from those who can use their influence to subvert the academy are enormous and may take years, perhaps decades, to show fruit. Unfortunately, the administrative leaders of the academy, presidents and provosts, tend to be in their positions for five years or fewer. This is hardly enough time to get the conversation going. Changing this equation by attracting good people into these positions and supporting them while they make the argument for the freedom of the academy is critical. Marshalling national education groups like the AAU, NASULGC, ACE and the AAUP to lead the fight on federal government issues can offset campus leadership's impermanence. The faculty, of course, go on forever and should not take lightly their responsibilities to speak out on issues that threaten to infringe campus prerogatives.

None of the above is intended to suggest that the academy should ignore society. We clearly must integrate the academic mission into society and be

accountable to the broader community or risk losing the support necessary to succeed. On the other hand, the pressure to bend the long-term mission of the academy to the short-term desires of individuals is pernicious and will serve no one well in the long-term. Funding shortages recently have caused public universities to be particularly susceptible to such pressures. Let us work for understanding to redirect these pressures to the long term good of the academy and society.

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