

# THE EPSCoR CHALLENGE:

## PARTNERSHIPS IN RESEARCH

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As many of you know, Ted Kuwana has served as the Project Director of Kansas NSF EPSCoR since its inception in 1992. After a short stint as Associate Director, I became Project Director in February of this year. Much of what I'll talk about today has been accomplished on Ted's watch, but I am pleased to offer a summary of where we are, and perhaps a few reflections of where Kansas NSF EPSCoR is headed and what lies ahead.

EPSCoR, the Experimental Program to Stimulate Competitive Research, is based on the premise that universities and their science and engineering faculty and students are valuable resources that can potentially influence a state's development in the twenty-first century much the same way that agricultural, industrial, and natural resources did in the twentieth century. EPSCoR's goal, therefore, is to identify, develop, and utilize a state's academic science and technology resources in a way that will support wealth creation and a more productive, fulfilling way of life for a state's citizenry. Begun in 1978 by the National Science Foundation (NSF), EPSCoR helps scientists in traditionally rural states to build a better research program and become more competitive in science and technology. The NSF EPSCoR Office actively cooperates with state leaders in government, higher education, and business to establish productive, long-term partnerships. In each EPSCoR state, the NSF's role is to stimulate local action that will result in lasting improvements to the state's academic research infrastructure and increased national R&D competitiveness. EPSCoR increases the R&D competitiveness of an eligible state through the development and utilization of the science and technology (S&T) resources residing in its major research universities. EPSCoR achieves its objective by:

1. stimulating sustainable S&T infrastructure improvements at the state and institutional levels that significantly increase the ability of EPSCoR researchers to compete for federal and private sector R&D funding; and

2. accelerating the movement of EPSCoR researchers and institutions into the mainstream of federal and private sector R&D support.

### *How Did Kansas Become an EPSCoR State?*

In 1991, Kansas was invited to join EPSCoR. An alliance of Kansas business people, government officials, and university faculty wrote a proposal to create an NSF EPSCoR program in Kansas. The proposed program would link faculty members at the University of Kansas, Kansas State University, and Wichita State University in cooperative projects; share major equipment resources; fund junior faculty to increase competitiveness for federal grants earlier in their careers; and stimulate formation of research partnerships among the university, state and the private sectors. After merit review of this proposal, NSF awarded Kansas a Phase I Infrastructure Program for 1992-1995. Since then, Kansas has received two additional infrastructure awards: Phase II from 1995-1999, and Phase III from 1999-2002.

### *Why Is Kansas an EPSCoR State?*

EPSCoR is restricted to those states that have historically received lesser amounts of Federal R&D funding and have demonstrated a commitment to develop their research bases and to improve the quality of science and engineering research conducted at their universities and colleges. In 1989, Kansas ranked 33<sup>rd</sup> among the states receiving federal R&D support. Kansas received less than one-half of one percent of all federal research dollars awarded to colleges and universities. In 1991, Kansas received \$20 per capita in Federal R&D dollars while the national average was \$38 per capita. In 1996, on a per capita basis Kansas received \$31 while the U.S. average was \$46. Another way of expressing this is that nearly \$40 million in federal taxes for R&D was lost, sent to states on the East and West Coast corridors. So as to dispel any illusion that there is a coastal influence, our neighbor Colorado has federal obligations of \$75 per capita, or nearly \$280 million compared to our \$80 million! Although accurate per capita data are not available for all states, in 1997 the total federal R&D obligations (and that includes obviously more than the National Science Foundation) for the period 1991–1996 changed in Kansas from \$20 to \$31 per capita. The national average for the same time period changed from \$36 to \$46 per capita. Regardless of the math used, at this rate it will take us a long, long time to get to a sufficient level in R&D dollars. The key is obviously research proposals that are highly meritorious and funded, since individual research proposals are the bedrock of research programs.

### *How Has EPSCoR Helped Kansas?*

Since entering the NSF EPSCoR program in 1992, Kansas EPSCoR has grown to include programs from: the Department of Defense, the Department of Energy, the Environmental Protection Agency, the National Aeronautic and Space Administration, and the National Institutes of Health. The Kansas NSF EPSCoR program has effectively changed the research paradigm by fostering inter-institutional, inter-state, and regional research projects. For example, a project headed up by Rob Denell at Kansas State University (KSU) used various model systems to increase knowledge about human development and disease, processes by which cells transmit signals regulating growth and development, mechanisms that regulate cell death during normal development, and the manner in which this mechanism is regulated by viruses during infection. This program resulted in the yearly Sunflower Developmental Genetics Symposium, which includes invited speakers chosen for their potential to interact with and mentor Core Members of the project. In addition to increasing research competitiveness and collaboration, Core Members' laboratories helped train 88 undergraduate students, 37 graduate students, and 15 postdoctoral scholars. The 14 faculty members on this project published 60 papers in 23 peer-reviewed journals or as book chapters, and generated more than \$6 million in extramural funding with grants from NSF, NIH, the March of Dimes, the American Cancer Society, the Muscular Dystrophy Association, and the Council for Tobacco Research. Thus, NSF EPSCoR helped generate more than \$25 million in new funding.

Another example is the project headed by Dr. Chu that partnered the University of Kansas (KU), KSU, and Wichita State University (WSU) to form the Kansas Center for Advanced Scientific Computing (KCASC). KCASC is a statewide interdisciplinary research infrastructure with three objectives: 1) to establish a mid-range multiprocessor supercomputing system for supporting advanced computational research in the sciences and engineering; 2) to foster advanced computational technology in interdisciplinary research by supporting interdisciplinary activities; and 3) to enhance the computational technology in Kansas to nationally and internationally competitive levels. In August 1999, NSF awarded \$593,435 to KCASC, which it combined with \$300,000 from KU to install 64 SGI Origin2400 processors with 16 GB memory and 200 GB disks. The need among KCASC researchers to access additional supercomputing resources helped stimulate development of the Great Plains Network, a regional high-bandwidth network linking six EPSCoR states with the national grid. Faculty associated with KCASC have received more than \$5.1 million in funding for their research.

Still another project, headed by Bob Zeigler at KSU, is the Great Plains Cereal Biotechnology Consortium, consisting of the Land Grant universities of Kansas, Nebraska, and Oklahoma. The Great Plains states produce a major portion of the world's cereals. Thus, global food security as well as the regional economy depends to a significant extent on the sustainability and economic viability of cereal grains production—primarily wheat, maize, and sorghum. Each university has specific and complementary strengths in the different cereals, and each has invested substantially in establishing plant biotechnology capacity. Consortium members will invest in their existing areas of strength. This will avoid duplicating thin coverage at each university and will create complementary foci of excellence in cereals biotechnology in the region.

A research program that has united the faculty across the campuses of KSU, KU and WSU involves the area of complex fluid flows. The three campuses will be joined by an active Internet link. The proposed research meets critical needs in materials processing, aviation, environmental air quality, and the chemical process industry. These areas are bound together by the common physics underlying all complex fluid flows and the need for an interdisciplinary effort to fully understand the ramifications. The program will be guided by an advisory committee of industrial and governmental scientists and administrators. The next time you are sitting out on the runway on an airplane with stale air, waiting to take off, you will have some appreciation for the research being done on complex fluid flows. Some of the cutting edge research involving air circulation through aircraft is an outcome of this program.

Another area where NSF EPSCoR has greatly helped to stimulate research is in the development of human infrastructure. Kansas NSF EPSCoR Faculty Start-Up initiatives are helping to fund seven new positions. At KU, the Department of Chemistry is recruiting a senior distinguished Professor and a junior faculty member in bioanalytical mass spectrometry. The Department of Physics and Astronomy, in an effort to rebuild its condensed matter physics program, has hired a new faculty member who will complement existing expertise in superconducting electroceramics. At WSU, the Department of Mathematics and the National Institute for Aviation Research have jointly hired a junior faculty member with expertise in numerical analysis and scientific computing, and the Department of Chemistry has hired a mass spectrometrists. KSU has recruited two junior faculty members, one in molecular plant biology and one whose expertise is in fungal biology, and one senior person in plant taxonomy and systematics.

Kansas NSF EPSCoR has also participated in the acquisition of a high performance computer at WSU that will make it possible for the faculty to perform leading edge research and write nationally competitive

research proposals. Wichita has a significant concentration of aircraft manufacturers (Boeing, Cessna, Raytheon, and Learjet) that are increasingly employing advanced computational programs. With the addition of a high performance computer, WSU will be able to assist these and other businesses and industries in solving complex problems and providing a trained work force. At the recent statewide EPSCoR conference held in Manhattan, Dr. Alexander, who headed up this equipment purchase, indicated that the time on this computer is saturated, further attesting to its multi-dimensional value. Kansas NSF EPSCoR also assisted in the purchase of a mass spectrometer for the Chemistry Department at KU for protein microcharacterization.

Another Kansas NSF EPSCoR initiative that has been a very special success is the First Award program. Newly hired faculty are asked to submit a research proposal to Kansas NSF EPSCoR in parallel with a proposal submitted to a program in the National Science Foundation. The EPSCoR proposals are competitively reviewed much like the *ad hoc* review program employed by the National Science Foundation. Our EPSCoR program provides rather quick turnaround time for proposals up to \$40,000 for a single year; the intent is to jumpstart new investigators so as to make their programs immediately competitive. These funds are often earmarked for undergraduate assistance, graduate students, and postdoctoral fellows in order to increase data acquisition, which is such an important part of NSF proposals today.

The First Award program in Kansas has provided approximately \$1.6 million to 44 faculty. These 44 faculty have generated an impressive \$21.2 million in external awards, with another \$20 million pending at this time. This past October, ten additional First Awards were provided to investigators at KU, KSU, and WSU. Average EPSCoR awards are approximately \$40,000; and in the competition for First Awards that will take place this fall, those funds will be elevated to \$50,000 dollars.

Kansas NSF EPSCoR has supported several special initiatives. One project involved the powerful Access Grid, which is changing the face of research, collaboration, and education. August 1-3 the University of Kansas hosted the Alliance Chautauqua Conference 2000, which showcased the Alliance Access Grid, including its ability to link powerful computers into a virtual machine room and to bring people together into virtual workspaces. Kansas NSF EPSCoR co-sponsored this three-day event together with the National Computational Science Alliance and KU. This program not only highlighted emerging new grid technologies and access grid visualization, but also focused on bioinformatics, computational materials science, Internet 2, chemical engineering applications, and real-time storm prediction and severe weather modeling.

The Science Workshop for Minority High School Students is another project that combined the strength of several EPSCoR programs. Co-sponsors were the Nebraska, Oklahoma, and South Dakota EPSCoR programs and the Brown Foundation. The purpose of the workshop was to encourage high school minority students to pursue careers in science, mathematics, engineering and technology, and to learn about educational opportunities at the state universities in the region. More than 150 high school students attended science lessons on DNA fingerprinting, the physiology of fitness, the analysis of particulates, laser ICP probing of rocks, tornado hazards, and physics and astronomy while their teachers discussed issues of common interest. Students enjoyed a college fair with information about universities in the region, a tour of the University of Kansas Natural History Museum and Biodiversity Research Center, and entertainment by the New Dawn Native American Dancers.

Kansas NSF EPSCoR has also sponsored strategic planning workshops. The value of strategic planning was underscored when Dr. Joe Heppert and colleagues were awarded a Hewlett Grant for \$240,000 and an NSF DUE award of \$2.4 million for K-12 teacher training in the sciences. Heppert was funded under a Phase II Planning Grant to engage statewide stakeholders to plan and develop these proposals. Kansas EPSCoR in turn contracted the Institute for Public Policy and Business Research (IPPBR) at KU to conduct strategic planning workshops. Of the three NSF EPSCoR grant proposals submitted in February 1999, two selected for funding had enlisted IPPBR for assistance.

Kansas NSF EPSCoR has paid for faculty travel to funding agencies. The program has arranged air transportation for five faculty to attend the February 9, 1999, Oklahoma NSF EPSCoR Regional Workshop in Materials Science. In addition, the program has fostered industry-university research partnerships. One high-profile industry/university partnership is the information technology program at KU that was initially funded by EPSCoR, later partnered with SPRINT and now has several industrial components. The program now generates several million dollars a year. The program has provided editing assistance to faculty writing proposals, and it has funded large infrastructure-building research projects.

Despite the impressive successes enjoyed by Kansas researchers and the NSF EPSCoR program, there is still much to be accomplished. We continue to experience barriers to research in EPSCoR states. These include: 1) faculty recruitment, development, and especially retention; 2) graduate student quality and quantity; 3) R&D infrastructure and institutional change; 4) recognition and reputation; 5) technology transfer; and 6) state support for higher education and S&T development.

Because success in research, at least within the sphere of university programs, requires well-trained researchers that are capable of writing successful fundable grants, faculty retention in EPSCoR states is of critical concern. The Kansas First Award program, for example, provides faculty with an early competitive edge in competitions for regular NSF grants. These early-career faculty now can be easily lured to more established universities that possess the infrastructure and lack research barriers. As a department chair, I can relate a scenario that is taking place as I speak. I have a faculty member who has two offers in hand, one from the University of Rochester, the other from Penn State University. We will need to provide a \$90,000 piece of equipment as just one of several items necessary to retain this bright and highly motivated scholar, who in the years to come will greatly contribute to the research mission in the state of Kansas—if we are able to retain him.

Finally, next year at this time we will be preparing the Phase IV grant proposal to the National Science Foundation EPSCoR program. This new round of grants will be up to \$3 million per year and will require a \$1.5 million per year match by the state. I am hopeful that our program will be successful, and that the potential \$13.5 million that will flow through the EPSCoR program to Kansas researchers will further enable us to increase our R&D competitiveness and to continue to enhance the partnership between universities, the private sector, and the state's citizenry.

In summary, Kansas NSF EPSCoR has: changed the research paradigm by fostering inter-institutional, inter-state, and regional research projects; assisted in the development of human infrastructure; funded multi-user equipment; provided start-up funds to faculty early in their careers (FIRST Awards); supported special initiatives; sponsored strategic planning workshops; funded faculty travel to funding agencies; fostered industry-university research partnerships; provided editing assistance to faculty writing proposals; and funded large infrastructure-building research projects. With the continued partnership that has been developed and nurtured among the state, universities, and federal government, EPSCoR in Kansas is making a significant imprint on the overall research enterprise of the state.

Table 1. Funds Awarded to Kansas NSF EPSCoR  
1992-1999  
in Millions of Dollars

<b>Date</b>	<b>Program</b>	<b>NSF Funds</b>	<b>KTEC Funds</b>	<b>Other Funds</b>	<b>Total Funds</b>
1992-1995	Phase 1	4.48	4.5	~2.0	10.98
1995-1999	Phase 2	5.25	5.06	~2.0	12.31
1999-2002	Phase 3	3.00	2.25	3.52	8.77
1994-2001	EPSCoR Grants (7)	4.455	1.437	1.085	7.077
1998-1999	Co-Funded Proposals (12)	5.32			5.32
<b>TOTAL</b>		<b>22.505</b>	<b>13.247</b>	<b>8.605</b>	<b>44.357</b>