

## Executive summary

### International Collaboration in the Social and Behavioral Sciences

David Lightfoot, Assistant Director, National Science Foundation  
Directorate for Social, Behavioral, and Economic Sciences

- Many kinds of collaboration are routine and involve no special mechanisms. A few years ago, NSF worked on recommendations about how we might internationalize work in the social sciences more effectively.
- The world has changed and made collaboration easier, mostly through easier travel and more effective telecommunications. Also science has changed and there is greater emphasis on interdisciplinary work.
- One of the major tools is what the US terms cyberinfrastructure and what Europeans term e-science. Now for the first time in the history of science all scientists use cyberinfrastructure for many purposes; new computational facilities have become part of the infrastructure of all the sciences.
- All of the initiatives discussed in this article have cyberinfrastructure at their core and that has been a major focus at NSF over the last few years, with the establishment of the Office of Cyberinfrastructure within the Office of the Director three years ago.
- Virtual organizations, drawing scientists together outside the bounds of geography, constitute a major tool for new international collaborations and we need to understand their possibilities as well as we can.
- Our experience is that joint proposals with parallel funding and parallel review processes are successful, because each funding body is getting more net research for their partial support of the overall project.
- The NSF is interested in cultivating international collaboration at the level of principal investigators from different countries who seek to undertake common research. Agencies from different countries can collaborate to develop the international infrastructure that is so needed by our sciences.

### International Research Collaboration: Just Nice to Have or Necessary?

Marion Müller, Director, North America Office, German Research Foundation

- The DFG is the central research funding organization that promotes research at universities and other publicly financed research institutions in Germany. Its foremost goals are promotion of collaboration between scientists and academics and cooperation with the respective national research funding organizations. Almost all of the DFG's funding schemes offer international components.
- Germany “pushes” students and young scientists to spend an extensive time period of their academic career outside of Germany, and also offers various sources to fund these times abroad. The US is the leading destination of choice for DFG-funded

postdocs as well as for conference and lecture trips. There are currently about 350 DFG-funded postdocs in the US.

- However, in the US, postdoctoral studies abroad are often considered as removing talented young scientists from the scientific mainstream and making it harder for them to compete on a difficult US job market after returning. Faculty members, academic advisers and graduate students across all disciplines seem to share the perception that tenure-track ambitions are incompatible with doing a foreign postdoc.
- The support for international collaboration is an integral part of the DFG's mission. The DFG has not only opened all its funding schemes to foreign nationals willing to do science in Germany, but it supports collaboration between German scientists and international partners in all of its funding programs and with a multitude of instruments.
- The DFG's Research Training Groups combine innovative top-level research and structured promotion of excellent young researchers in an international setting. A key objective of Research Training Groups is to enable the speedy research-related qualification of doctoral researchers. Doctoral researchers are enabled and expected to conduct independent research early on. Research Training Groups aim to accelerate doctoral training and lower the age at which scientists and academics finish their doctorate.
- Intensive large scale and medium-term collaborations need careful preparation and long-term planning. Preparatory trips or collaboration visits to the partner's institute or department can be supported through the DFG's international cooperation funds. Likewise, funding for bilateral events is provided to facilitate cooperation between scientists and academics with the aim of developing scientific contacts.
- One of the largest obstacles in international research collaboration is so-called double jeopardy, the dependence on separate funding decisions by each of the funding agencies in the USA and Germany. As long as international research collaboration is exposed to double jeopardy, one cannot blame researchers if they opt out for the safe way; namely to design a research project where the international collaborative component is nice to have but not necessary and comes into the picture only once national funding has been secured at both national fronts.
- International research collaborations are nice to have, of course, but more than that they are increasingly and vitally necessary to tackle important challenges and to keep science successful and competitive. However, the different stakeholders, not least the funding agencies, university managers and policymakers, must create a habitat where international collaboration can truly thrive and bear fruit.
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## **Lessons Learned from International Research Partnerships**

Prem Paul, Vice Chancellor for Research & Economic Development,  
University of Nebraska-Lincoln

- International research partnerships have played a critical role in increasing food availability in many developing countries. Two of UNL's current international programs are collaborative partnerships; we highlight lessons learned from these two efforts to inform the creation and foster the success of other international partnerships.
- The goal of the UNL- University of Zambia (UNZA) partnership is to build capacity to better confront infectious disease, especially HIV/AIDS and AIDS-associated diseases. The Nebraska-based Fogarty training program's ultimate aim is to help biomedical personnel in Zambia slow or halt HIV transmission and minimize the negative health effects of HIV/AIDS-related malignancies and diseases. Zambia's Ministry of Health is so pleased with the program's successes that it uses the Nebraska Program as a model of U.S.-Zambian collaboration.
- UNL has a number of collaborations with various Chinese research and education institutions. Research and training collaborations have been set up with Nankai University, which is among the top 10 universities in China. The Nebraska Fogarty Training Program has provided training for 13 Chinese fellows. So far every fellow who has completed the training program has resumed their former post and actively engaged in HIV/AIDS and AIDS-associated disease research.
- INTSORMIL is a USAID program established to provide research and training support to developing countries. Among the global strategies of the INTSORMIL program are: Sustainable crop production systems, sustainable plant protection systems, germplasm enhancement, crop utilization, technology commercialization, and building national agricultural systems. UNL has led the INTSORMIL in West Africa since its inception and successfully won the 2006 renewal competition. The majority of the INTSORMIL-trained workforce has returned home with new skills, enhancing in-country capacity through research and administration.
- Recently, funding from USAID has been significantly reduced, but several important CRSPs like the INTSORMIL have continued to receive support. More recently, NIH's Fogarty International Research and Training program has provided funding for infectious disease research in West Africa.
- Mutual trust and common goals lead to mutually beneficial relationships; these are among the most critical factors when forming successful partnerships. Retention of the talent pool in partner countries is critical. Individuals that emerge from these programs are frequently highly sought after because there is enormous competition for well-trained workers in developing nations. Program sustainability is important – without it, the impact on in-country capacity is minimized. Programs that help provide new skills to local citizens can help create new businesses and improve local economies are often successful.

## Facilitating Faculty-Driven International Initiatives

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

- A major, research extensive university must recognize the global scope of effective scholarship and strive to instill a global perspective in the classroom, in research and scholarly activities.
- This concept of free and open inquiry is at the core of the higher educational mission of a vibrant university. The goal is for the university to achieve a curriculum that remains sensitive to a global perspective and seeks to optimize international linkages. Achieving such a goal requires the active participation of the faculty of the institution. Universities must be proactive to reach the goal of globalization. Kansas State University's Office of Research and Sponsored Programs (OSRP) has identified four challenges that the research administration can address to make globalization and international collaborations a reality.
- Faculty is the key in international collaboration, and distance is an activation energy threshold that needs to be overcome for such collaborations to flourish. One strategy is to present funding opportunities to the KSU faculty in both a timely and a frequent basis. A database specialist is available to assist every faculty member, and especially those in the first several years of their appointments, in obtaining information on funding sources beyond those like NSF and NIH that are well known.
- Graduate education is a global enterprise. Over a half million foreign students studied in the United States in 2005, and our nation is not unique in hosting international students. We should be using these students to cement research linkages abroad. International doctoral students often return to their home countries and join the scientific workforce at home. US faculty members, therefore, have a ready source of collaborators by relying on their own graduates. As these collaborations mature, the internationalization of graduate education could potentially be institutionalized by the establishment of joint degree programs.
- There are legal and ethical challenges when faculty members initiate projects that will be managed overseas. Universities will be expected to be in compliance with the laws and regulations at home, made difficult when the funds are spent overseas.
- A modern university has the obligation to its faculty, students, and stakeholders to ensure the global nature of its research enterprise. The offices that provide the research administration for the university must have that mindset as well. At KSU, the Office of Research and Sponsored Programs strives to provide this for our stakeholders.

## Think Globally, Organize Systemically

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

- US research universities are not currently structured so as to enhance the success of international collaborations. Integrating systems science into the administrative architecture is a key solution.
- There is considerable difficulty in discerning what is actually feasible in an international research collaboration, what complications will occur, and in foreseeing unintended consequences. Many factors that come into play include importation issues, fiscal issues, and socio-cultural issues. Investigators need constant and frequent updates on changing regulations and sociopolitical circumstances. However, this kind of resource is nearly nonexistent. Most US universities are addressing globalization at the level of undergraduate education.
- A very important trait of interactions in complex systems is that the outcomes, products, eventual states, of a system are not evident from merely examining the participants. Complex systems have 'emergent properties', or behaviors not predictable by examining individual elements. It takes multiple perspectives and approaches to unravel complex interactions.
- There is only one sort of organization where the disparate disciplines needed to unravel the emergent properties of complex systems commonly co-occur: the research university. The problem of integrating the disparate interests for international collaboration is truly daunting. Institutional culture leaves it to the individual researcher to solve these problems, but this engenders a real opportunity cost.
- All research programs are increasingly international research programs, whether the researcher goes abroad or not. Yet training, at least in the sciences, continues to focus on what happens in one's field, on one's campus, in one's lab or office. Researchers who do go abroad are challenged to decipher unexpected factors ranging from minor annoyances to major interference.
- Research universities should be able to provide information about the factors that will influence the work abroad to researchers. An officer or entire staff whose job it is to help researchers become aware of global issues when developing research projects would contribute greatly to the university's mission.
- Because academics are trained to focus narrowly and develop their research in a domestic setting, they would benefit from an agency whose role is to suggest or even outline the complexity of the system in which their research will be carried out. Universities should consider systems analysis a critical element in the academic administration system, since the benefits range from enhancing their own effectiveness to their global impact.

## **Biodiversity Prospecting and Conservation Programs: Models for International Collaboration**

Barbara Timmermann, University Distinguished Professor and Chair, Dept. of Medicinal Chemistry, University of Kansas

- An International Cooperative Biodiversity Groups (ICBG) Program was awarded in 1993 for research into drug discovery from medicinal plants, biodiversity conservation and economic development in Latin America. This ICBG program, entitled “Bioactive Agents from Dryland Biodiversity of Latin America”, serves as a model for the implementation of the ICBG principles, which are, ultimately, the principles of the United Nations Convention of Biological Diversity (UNCBD). Based on this model, bioprospecting research continues at KU.
- The drug discovery and development goal of this ICBG is to identify biologically active molecules from plants as chemotherapeutic candidates for tuberculosis, cancer and other diseases of concern to developed and developing countries.
- One of the project’s central goals was to address and promote biodiversity conservation and sustainable economic activity, including minimizing negative environmental impacts while ensuring that equitable economic and social benefits from discoveries accrue to the country, community, and organization which facilitated the discovery of the natural product.
- The successful collaboration of the members of this ICBG required detailed agreements among the various participants, which defined work and funding commitments, ownership of materials, licensing rights and distribution of future financial benefits, if any. Each two-way agreement defined the scope of work obligations of the University and of the collaborator.
- The real benefits from these types of collaborations are in the collaborative interactions established among the participating countries, the databases developed as a result of the project, the technology transfer and the training of students and faculty through active exchange programs.
- From our direct participation in the ICBG efforts in search for biologically active agents from terrestrial plants, we can conclude that such an endeavor is a very complex process that requires the involvement of not only scientific expertise, but also expertise in a variety of human activities including diplomacy, international laws and legal understandings, social sciences, politics, anthropology, sociology and knowledge of local language and culture.
- In the long term, this project has built institutional and international relationships between the U.S. and developing countries that will continue to grow beyond the life of the project and will serve as an effective model for others who seek to develop similar relationships.

## **Partnering In China: A Case History**

Barbara Couture, Senior Vice Chancellor for Academic Affairs, University of Nebraska-Lincoln

- China is the most rapidly changing economy in the world—a fact that no institution, private or governmental, can ignore. The social, political, industrial, and ecological impacts of China’s rise are world-wide and affecting us nationally
- Beyond China’s importance to our economy and its reliance on our research universities to fuel innovation, China poses tremendous potential as a source of new university students. China, at present, has fewer than 1000 universities and 9.5 million potential freshmen. Only 2.7 million have hopes to enroll.
- International programs require a solid, open, and well-articulated partnership between the cooperating institutions. All personnel associated with partnership need to first and foremost understand their roles in securing the partnership; these individuals’ commitment to those roles will assure that the partnership is institutionally grounded.
- In pointing to our case study partnership with XJTU, we focus here on seven strategies that can lead to a partnership with a foreign institution that succeeds:
  - Assure institutional compatibility
  - Build on existing relationships
  - Recruit institutional brokers
  - Make and honor agreements
  - Create a physical presence
  - Develop a shared story
  - Practice patience
- Partnering with China can be rewarding and beneficial for research universities here and in China. The benefits to UNL have been visible and immediate. When all our partnership degree plans with XJTU CC are fully realized, we will add 500 new Chinese undergraduate students to UNL each year. Because we are under capacity in our undergraduate operations, this means a substantial increase in tuition revenue as well as an economic boost to Lincoln.

## **The Tribolium Genome Project: An International Collaboration**

Susan Brown, Professor of Biology, Kansas State University

- The large data sets produced by genome sequencing projects have spurred the formation of global collaborations that are highly interdisciplinary. The Tribolium Genome sequencing consortium is an example of such a collaboration.
- In today’s research world, it takes an international consortia of scientists to organize their efforts: first to justify a genome sequencing project, and then to coordinate the annotation efforts once the sequence is in hand. Interactions between consortium members have lead to several federally and internationally supported projects, some

of which continue today, past the formal conclusion of the genome sequencing project.

- We proposed sequencing the genome of the red flour beetle *Tribolium castaneum*, a world-wide pest of stored grains. The red flour beetle is now the third best invertebrate model organism for genetic studies of development, physiology and toxicology after *Drosophila* and the free-living nematode, *C. elegans*. Sequencing the *Tribolium* genome provides our first insight into a Coleopteran genome, and there are more species in this order than in any other.
- Several research groups, predominantly in the US and Europe, use *Tribolium* as a model system in which to study the genetic regulation of development; Evo-Devo studies. Analysis of the *Tribolium* genome was expected to provide insight into developmental studies in both fruit flies and vertebrates. Genome sequencing projects require funding from multiple sources. Academic, industrial and federal agencies contributed to the *Tribolium* Genome project.
- Computational analysis of the genome revealed more than 16,000 gene models. A subset of these needed to be manually evaluated to determine the quality of the genome sequence and the value of the computer generated gene models. More than 100 scientists from 67 institutions world-wide provided the initial analysis of the *Tribolium* genome.
- **The future of genome sequencing projects.** The first wave of genome projects was federally funded and their progress was followed in detail by the entire research community, as befitting a new research paradigm. The second wave of projects was also justified by white papers. With the advent of new sequencing technology, genome sequencing projects are now in the realm of individual research grants. Soon a genome sequence may be considered preliminary data for a research project grant. Even when it reaches this stage, sequencing the average eukaryotic genome will be an international collaboration, uniting researchers world-wide, through their interest in the next genome.

### **An International Initiative in Biomedical Research Training**

Salvatore Enna, Associate Dean for Research and Graduate Education, University of Kansas Medical Center

- One stimulus for internationally coordinated educational programs is the need to preserve fundamental research technologies that might otherwise be lost.
- Paleo drug discovery was a linear process, with all experiments conducted in humans, and the only endpoints being efficacy and safety. Modern drug discovery began in the 19<sup>th</sup> century as a result of advances in chemistry and physiology. By the mid-20<sup>th</sup> century it was clear that drugs exert their effects by interacting with biochemical pathways, and that the physiological and clinical responses to these agents result from effects at the cellular level.



- Towards the end of the 20<sup>th</sup> century, advances in molecular biology opened new avenues for drug discovery. The Molecular Period which began in the 1980's and extends to the present, is characterized by a shift in the initial objective of drug discovery from first identifying agents that display efficacy and safety, and therefore likely clinical activity, to first identifying agents on the basis of their target selectivity, which may or may not ultimately prove to be of any clinical benefit.
- As federal support for physiological research waned in comparison to molecular studies, investigators and academic departments abandoned work in the former to concentrate on the latter. Besides slowing advances in the physiology sciences, over time this change of priorities reduced the number of faculty with interests and expertise in this area, thereby diminished training opportunities in the field.
- The decline in IOSP training has led to manpower shortages in the field in the pharmaceutical industry and government regulatory agencies. It is speculated this lack of expertise and the steady erosion in the population of those capable of teaching IOSP are responsible, at least in part, for the decline in the number of novel drugs reaching the market.
- In 2004 the United States National Institutes of Health (NIH) began funding short courses in integrative and organ system pharmacology. Currently, the NIH supports summer IOSP short courses at four institutions. The International Union of Basic and Clinical Pharmacology (IUPHAR) assembled a task force to assess the global need for IOSP training and to design programs to meet the demand for such instruction at strategic locations around the world.
- As the IUPHAR program involves collaboration among academic institutions around the world, it is a prime example of a global research and training initiative. This undertaking exemplifies how academia, industry, and federal governments can work together in pursuing a common goal.

### **International Medical Research Infrastructure: KUMC and Beyond**

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

- The advent of the internet has enabled researchers to communicate without geographic bounds and thus research is no longer geographically restricted. US universities must have a global presence in order to remain competitive.
- There are several benefits of developing an international research network. The expertise provided by the various partners will allow broadening of the research goals and technologies utilized in the research. Additional benefits include enhancing the institution's competitiveness for grant opportunities, engaging new students, staff, and faculty with outstanding credentials. For clinical trials, the patient base may be increased.

- International collaborations can enhance discovery and strengthen research programs by integrating basic and clinical research where feasible, to encourage translational research. In establishing international collaborations, a solid vision is required including short and long term goals.
- India is launching an open source drug discovery initiative to accelerate development of new drugs to treat infectious diseases of worldwide importance. It is establishing a web-enabled interactive open source platform that will list the current design challenges for developing drugs to treat drug resistant tuberculosis, malaria and HIV.
- Why use open source? First, the goal is to help resolve key scientific and drug discovery problems with multiple inputs thus accelerating drug development/discovery in specific disease areas. One driving force for using open source is that many of the drug discovery problems are complex requiring many labs for insights. However, the timing of disclosure, protection of the discovering scientist(s), and subsequent product patent filing limitations may all be formidable issues.
- The KU School of Pharmacy has a high national ranking as evidenced by their continued success with NIH funding, training of students, and the quality of their faculty. Major strengths are in the areas of Chemical Methodologies Library Design and Drug, Discovery, Development and Delivery. Whether an open source discovery program would facilitate the movement of drugs through the pipeline is uncertain at this time. However, enhancement of collaborations at the local, national and international levels is critical for future success.

### **The Global Land Grant University: What Does That Mean at Mizzou?**

Brian Foster, Provost, University of Missouri

- MU's international activities are extensive. They involve research, graduate and undergraduate instruction, Extension, and economic development. They are diffuse and deeply embedded across all colleges. Nevertheless, international programs are often marginal to the institution. They lack continuity, organizational support, centrality and a compelling narrative to build adequate political support. In short, they are interesting, challenging, productive—but they are not a key priority by consensus! We are global—but under the radar.
- MU has a long history of international involvement. Consider the following.
  - 1500 international students in 2007-08—about 5% of total enrollment
  - 1,000 international visiting scholars traveling on J-1 visas
  - More than 1,100 students earned academic credit abroad in 2007-08
  - MU has active agreements with over 160 international universities and government agencies.
- **FAPRI in Ireland and the UK:** MU's Food and Agricultural Policy Research Institute's (FAPRI's) made an analysis of agricultural policy in the United States.

Upon the invitation of the Prime Minister, FAPRI began a long-term project that addressed the implications for Ireland of a series of agricultural policy reforms that the EU was considering.

- **Pasture-based Dairying in Missouri:** A new kind of dairy farm is emerging in Missouri, modeled on a pasture-based system of dairy production, much of which was developed in New Zealand. Since 2004, these pasture-based dairies have produced more than \$12 million in annual milk sales, with more than \$37 million in total economic impact, and 330 new jobs. The New Zealand connection, facilitated by MU Extension, has opened a new kind of dairy production that has had significant impacts on the Missouri economy, on local communities, and in general, on the quality of life in Missouri.
- **MU Programs in East Africa:** MU's current project, the Southern Sudan Revitalization Project, will manage about \$4 million per year in facilitating activities of USAID in the area. Among other activities, MU will conduct a census that is necessary for the upcoming election. In addition, there will be work on such issues as land title laws and on creating viable government agencies. The MU project in Southern Sudan is seen as a possible model for addressing issues in Darfur.
- **University of Missouri and University of Western Cape:** A large majority of South Africans receive treatment from traditional healers, using traditional therapies developed over centuries, treating conditions ranging from the common cold to HIV/AIDS. The effectiveness and safety of these therapies have not been scientifically addressed. The TICIPS program (The International Center for Indigenous Phytotherapy Studies), under direction of PI William Folk (MU Professor of biochemistry), is pursuing such studies, with the goal of incorporating these traditional therapies into conventional health care systems.
- It is clear that this international commitment shows a strong land-grant mind set. There is much more at MU than the land-grant mind set and mission—basic research, liberal arts education, and professional education, for instance. But the land-grant mind set has enriched all aspects of the complex MU mission.