Voice of Experience
International Research Infrastructure and The Impact of Export Control Regulations

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Abstract
Research today has become very complex, often involving international collaborations among multidisciplinary teams. Many institutions, especially those in less economically developed countries, have a great deal of expertise to contribute to these collaborations, but often lack the instrumentation, training, and research management infrastructure needed to support their endeavors. While non-profit organizations provide assistance with instrumentation and training to support the research infrastructure, efforts from the United States are hampered by Export Control Regulations. An appropriate balance is needed to develop research collaborations with universities in other countries while protecting United States security interests.

Introduction
Administrators International (SRA) celebrates its 40th anniversary. Originally founded as a North American organization, with four sections in the United States and one in Canada, SRA has grown into a truly international society. To reflect its growing global membership, SRA added the term "International" to its name in 2000. Members today come from nearly every part of the world (Table1). As SRA has increased its international membership and diversity of research management interests, it has remained dedicated to its mission of training and career development for research managers and administrators through formal educational offerings, exchange of best practices and continual networking among members.

The face of research, too, has changed over the years. Seldom is research confined to a single team working at one laboratory. As research has become more complex, sub-specialties have developed in scientific disciplines, and special expertise in using complex research procedures and instrumentation is critically important. Not every institution can afford the increasing cost of highly sophisticated instrumentation, such as nuclear magnetic resonance spectroscopy (which can reach hundreds of thousands of dollars, even before maintenance and personnel costs), and funding sources are not able to pay such costs. This has led to the growth of multidisciplinary, collaborative research that is no longer confined to a single laboratory or nation, but involves multiple institutions internationally.

Table 1

Countries with Representation in Society of Research Administrators International

Algeria	Georgia	Moldova	Spain
Armenia	Germany	Netherlands	Sweden
Australia	Ghana	New Zealand	Tanzania
Azerbaijan	Hong Kong	Nigeria	Thailand
Botswana	India	Pakistan	Ukraine
Brazil	Ireland	Republic of South Africa	Uganda
Cambodia	Israel	Russia	United Arab Emirates
Canada	Jamaica	Scotland	United Kingdom
Denmark	Japan	Senegal	United States
Egypt	Kazakhstan	South Korea	Uzbekistan
England	Kenya	Southwest Africa	Virgin Islands
Finland			

As the complexity and globalization of research have grown, regulations governing research also have become more complex. Institutions in the United States and elsewhere have learned to deal with the regulatory and policy differences attendant with the globalization of research. To meet the needs of universities and other organizations engaged in research, SRA has provided training and professional development opportunities to improve the research management infrastructure of institutions throughout the world.

It has been said that the path to economic and human development in a global knowledge economy is through increased education. Organizations such as the U.S. Civilian Research and Development Foundation (CRDF), the Carnegie Corporation, and the John D. and Catherine T. MacArthur Foundation support efforts to increase the capacity for higher education and research in Africa, states of the former Soviet Union, and elsewhere. These groups support the research efforts, complex equipment, and the development of research management infrastructure at universities and other organizations needed for international collaborations. Other U.S.-based foundations, such as the Bill & Melinda Gates Foundation, the Rockefeller Foundation, and the Ford Foundation, have invested heavily in developing local solutions to local and global problems through research.

Despite the continued efforts of these groups and others to support research organizations and researchers, United States Export Control Regulations can be a barrier to collaborations between scientists in the U.S. and around the world. Understanding these restrictions is critical if we are to engage in global research.

This article describes United States Export Control Regulations and the needs of international researchers for access to training, the latest technologies, and the infrastructure support of their home institutions. Examples of the needs of universities in Africa, Russia, and states of the former Soviet Union are presented.

An appropriate balance must exist among the U.S. need for national security, support for educational advances in other countries, and advances in research that can only be achieved through international collaborations.

An Overview of Export Control Laws and Regulations

Current U.S. export laws control dissemination of a wide range of technologies in a way that may have an adverse impact on research and the ability of international researchers to perform competitively. U.S. laws and regulations control the conditions under which certain information, technologies, and commodities can be transmitted overseas to anyone, including U.S. citizens working overseas, or to a foreign national, even if he or she is working in the U.S.

Export Administration Regulations

The responsibility of the Bureau of Industry and Security (BIS) in the Department of Commerce is to apply and enforce the Export Administration Regulations (EAR), which implement the Export Administration Act of 1979 (Export Administration Regulations Database). The EAR is responsible for regulating the export and re-export of many commercial items, including those often referred to as "dual-use." Dual-use items have both military and commercial applications. Some examples of these items are software, chemicals, and technologies such as aircraft power transmission systems. A list of these items can be found on the BIS webpage (Export Administration Regulations Database).

A small percentage of U.S. exports and re-exports that the EAR regulates require a license from BIS. There are 10 specific categories that require a license: nuclear materials; chemicals, microorganisms, toxins; materials processing; electronics; computers; telecommunications; lasers and sensors; avionics; marine; propulsion systems. The requirements for a license depend on, among other things, what item is being exported, where it is going, who is going to receive it, and how will it be used.

International Traffic of Arms Regulations

The mission of the International Traffic of Arms Regulations, or ITAR, is the control of arms sales to foreign parties to protect U.S. national security and to further U.S. foreign policies (22CFR120 – 130). The regulations of defense items are overseen by the U.S. Department of State. ITAR is responsible for regulating export and import of defense items that the United States Munitions List (USML) covers, or items that are inherently military in nature (designed to kill/defend against death in a military situation). ITAR also serves as a judge for license applications for exports, dealing with matters related to defense trade compliance and enforcement, and making reports on defense trade available to Congress and the public.

ITAR has 21 categories that require a license, including weapons, chemical and biological agents, vehicles, missiles, equipment, and all satellites. Among the problems ITAR can create for research organizations includes the expansion of its jurisdiction to research satellites, related technology and data. Universities that had been developing their own research satellite capabilities now must deal with an export regime applied to spy satellites and military rocketry.

A second issue for research organizations is the increasing application of ITAR to the life sciences. For instance, after 9/11 applications of export control regulations to research quantities of bacterial specimens were considerably stricter due to heightened national security.

Office of Foreign Assets Control

The Office of Foreign Assets Control, or OFAC, is part of the Department of Treasury. OFAC is responsible for administering and enforcing economic and trade sanctions. These sanctions are governed by U.S. foreign policy and national security goals in defense against terrorists, drug traffickers, and the proliferation of weapons of mass destruction. OFAC has the authority to impose controls on transactions and to freeze foreign assets; these controls can be either comprehensive or selective.

OFAC regulations often provide general licenses authorizing the performance of certain categories of transactions (Foreign Assets Control Regulations). OFAC also issues specific licenses on a case-by-case basis under certain limited conditions. OFAC oversees limited transactions referred to as "prohibited transactions," which are trade, financial and other dealings in which U.S. persons may not engage unless authorized by OFAC or expressly exempted by statute. However, each program is based on different foreign policy and national security goals, so the prohibitions may differ between various programs. Generally, a license may be required any time a research collaboration involves a person with citizenship in, or institution located in, one of several countries (e.g., various countries in the Balkans, Belarus, Burma, Cote d'Ivoire, Cuba, Democratic Republic of the Congo, Iran, Liberia, North Korea, Sudan, Syria, and Zimbabwe), and there are contractual or financial dealings.

The National Policy on the Transfer of Scientific, Technical, and Engineering Information - NSDD 189

The National Policy on the Transfer of Scientific, Technical, and Engineering Information, or the National Security Decision Directive (NSDD) 189, holds that the products of fundamental research are to continue to be unrestricted. This policy, created under the Reagan administration in 1981, defines fundamental research as: "the basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons."

The NSDD 189 provides that:

> Where the national security requires control, the mechanism for control of information generated during federally-funded fundamental research in science, technology and engineering at colleges, universities and laboratories is classification. Each federal government agency is responsible for: a) determining whether classification is appropriate prior to the award of a research grant, contract, or cooperative agreement and, if so, controlling the research results through standard classification procedures; b) periodically reviewing all research grants, contracts, or cooperative agreements for potential classification. No restrictions may be placed upon the conduct or reporting of federally-funded fundamental research that has not received national security classification, except as provided in applicable U.S. Statutes. (National Policy on the Transfer of Scientific, Technical, and Engineering Information)

This clause from the NSDD 189 is important because it maintains that fundamental research that has not been classified as important to national security must remain free and unrestricted. If the national security interest is important enough to trump the need for open transfer of information in support of research, the Directive requires

that the information be protected under the National Security Classification system.

Federal Research Exclusion

In response to academic concerns that export control regimes would stifle basic research, the Federal government created the Fundamental Research Exclusion to allow free transmission of solely fundamental research information that is already available in the public domain to full-time employees of an institution or university for educational instruction. This exception to the application of the various export control regimes applies only to information that is published and in the public domain, and only in the U.S. at accredited institutions of higher learning. According to Eric Iverson at a Public Policy Colloquium in 2002, "In the absence of this policy, universities would need an export license for each foreign student matriculated, each foreign researcher invited, and each collaboration with a foreign institution." (Iverson, E., 2002).

The Fundamental Research Exclusion can be lost in a federally funded project where a university accepts specific national security controls. Under the EAR, as opposed to the ITAR, the exclusion may not be lost even if a university accepts greater restrictions on its rights to disclose. However, the scope of pre-emption of the regulatory exclusion is not clear, and universities should never accept contract or grant language that purports to override the Fundamental Research Exclusion.

The Fundamental Research Exclusion also applies to full-time employees under ITAR. This allows disclosures of unclassified technical data in the U.S. by U.S. universities to foreign nationals who are bona fide, full-time regular university employees whose permanent residence throughout the period of employment is in U.S. However, this exemption may not be applied when the employee is a national of an embargoed country. Some of ITAR's embargoed countries include Afghanistan, Belarus, Cuba, Iran, Libya, North Korea, Syria, and Vietnam. In addition, ITAR allows the employee exemption only when the university informs the employee in writing that data may not be transferred to other foreign nationals without government approval. There are additional limitations. Some researchers, such as graduate or doctoral students, may not have full-time employee status, and some types of visas may require holders to maintain foreign residence.

National Security in Conflict with Global Interests

The problem for researchers and research administrators that arises from regulations such as the EAR and ITAR is the expansive definition of "export." Understanding when export controls apply, when a license is required, and when there are no exemptions available is problematic because of the complexities of agencies, policies, and range of covered activities and materials. To engage in non-fundamental research collaborations, institutions must obtain a license before export-controlled items or information can be shared abroad or on a U.S. campus with foreign nationals participating in the research. When restricted countries are involved, there may be no licenses available at all. The destinations most often subject to restriction include both major powers such as China, India, Israel, Pakistan, Russia, and countries that are often the site of international collaborations: various countries in the Balkans, Belarus, Burma, Cote d'Ivoire, Cuba, Democratic Republic of the Congo, Iran, Liberia, North Korea, Sudan, Syria, and Zimbabwe. Other restrictions apply to conferences only where unpublished research is presented, such as who can attend or co-sponsor the meeting. Institutions will face even more restrictions

when the activities involve teaching foreign collaborators how to use items in research ("defense service") or when transfers of research equipment abroad is proposed.

In his 1948 address to the Centennial Anniversary of the American Association for the Advancement of Science Annual Meeting, President Truman said,

> Continuous research by our best scientists is the key to American leadership and true national security. This work may be made impossible by the creation of an atmosphere in which no man feels safe against the public airing of unfounded rumors, gossip and vilification. (Truman, 1948)

To bring these issues all into perspective, the following quote from the Association of American Universities, made during a homeland security workshop, conveys the impact of the above mentioned policies and regulations.

> Increasing restrictions on the communication of and participation in research, including agency efforts to create new categories of 'sensitive' but unclassified research and to insert restrictions through regulations and through clauses in contracts, threaten the core university value of openness in scientific research. (Ehringhaus, Owens, Smith, and Turman, 2003)

What Is Being Done

There is a considerable need for education and the development of international research collaborations by economically less-developed countries. Some successes have been achieved, but there is a tremendous opportunity to do considerably more. There are many challenges facing research faculty and administrators from less developed countries as they try to build and sustain world-class research programs. This includes the need for additional training, availability of the latest technologies, the opportunity to collaborate with investigators in the United States and elsewhere, and support for their research programs. The following examples describe some international efforts that have yielded successes, the greater challenges ahead, and the need for additional collaborations and support for research, its infrastructure and its management.

African Experience

The Association of Commonwealth Universities has reported in a survey of African universities that only one reported submitting between 250 and 500 proposals annually, low by American standards for a research institution (Kirkland, J. 2005). However, universities in Africa are very interested in building their research programs and research management infrastructure (Stackhouse, J. Sultan, J., and Kirkland, J. 2001). In particular, the Carnegie Corporation provided support for SRA International to bring six chief executive officers from universities in Ghana, Nigeria, Tanzania, and Uganda to the United States in the spring of 2003 to learn about research management and meet with U.S. federal research funding agencies. The goal was to enable all participants to learn more about the American research management system and to begin to build collaborations between American and African universities. These meetings, held at the Northeast Section of SRA, at universities in the United States, and at federal agencies in Washington, D.C., were followed by week-long training workshops in research management at the six Carnegie partner universities between June, 2004 and March, 2006. Workshops were organized and presented by SRA members. An example of the building of the research management infrastructure in Nigeria is discussed below.

In another program, the Carnegie Corporation is supporting a project that aligns SRA with the Association of Commonwealth Universities and the Southern African Research and Innovation Management Association to engage a number of universities in a year-long needs assessment and planning exercise to develop a comprehensive plan for staff development and education in research management for universities across the African Continent.

Nigerian Experience

Nigeria is the most populous nation in Africa, and has a system of over 80 national universities, many of which were established at the time the country became independent in 1961. The Nigerian national universities are awakening from nearly 20 years of neglect by their federal government. Once thriving research centers such as Ahmadu Bello University, Bayero University and the University of Ibadan, have an aging faculty, outdated equipment for which parts are no longer available, and decaying laboratories. Some faculty and students conduct manual experiments, much as they did in the 1960s. Some equipment that is available cannot be installed because of the cost of laboratory renovation and the training of staff to operate the instruments. Another hardship is that dependable electric power is always subject to fluctuations, which can strain components of state-of-the-art instruments. Supplying back-up generator power to an entire university is not an effective solution due to the unaffordable cost of diesel. These power interruptions and fluctuations result in loss of computer services, with the result that many experiments must be repeated.

Despite these hardships, there are some re-emerging pockets of world-class research. Research efforts are supported by limited university funds and monies provided by the MacArthur Foundation and the Carnegie Corporation. These funds partially support faculty development, the purchase of new equipment, and the development of research infrastructure, such as information and communications technology networks and improved reference libraries. For instance, at Ahmadu Bello University, there is a thriving nuclear energy research program supported by the government that may one day enable the country to provide reliable power throughout the region.

The virology research program at the University of Ibadan is focusing on HIV and malaria research in very sophisticated biosafety level II and III laboratories with modern equipment provided by the Bill & Melinda Gates Foundation. This lab and others at the university medical center have continuous electrical power supported by a grant from the World Health Organization.

The Nigerian universities are establishing a number of collaborations with institutions in the United States and Europe. In particular, the University of Ibadan has about 40 international collaborations and receives National Institutes of Health (NIH) funding through subcontracts from universities in the United States. However, any international collaborative program only operates successfully if there is adequate funding for both the U.S. institution and its Nigerian collaborator. Often funds are available for the U.S. partner, but unless there is some mechanism for channeling money to enable the African partner to participate, the collaboration has little value. The African universities must learn research management to meet federal flow-through requirements. Fortunately, some sponsors are realizing the reality of the situation, and finding ways to resolve the issue.

At present, the Nigerian universities have only small pockets of research. To increase the breadth of their research programs,

they need access to the latest laboratory instrumentation and extensive training in state-of-the-art techniques. This can be accomplished through collaborations in the United States and elsewhere. The Nigerian universities also are conscious of the need to develop and implement a research management infrastructure.

SRA International, with support from both the MacArthur Foundation and Carnegie Corporation, is working with seven Nigerian institutions to build their research management capacity. The MacArthur Foundation, in May 2007, sponsored representatives from SRA International to conduct site visits of MacArthur-sponsored Nigerian universities. The goal of the site visits was to review their research programs and research management infrastructure, discuss research management with them, and identify two universities that would gain the most by sending a delegation to the United States to visit American universities to build research collaborations and learn how American Universities conduct research management. In addition, the delegations are to attend the 2007 SRA International Annual meeting and visit U.S. federal government funding agencies.

The Former Soviet Union

At the time of the fall of the former Soviet Union, universities and research institutes in Russia, Georgia, Kazakhstan, Moldova, Ukraine and other newly independent countries were left without public support. Research programs that once were directed by officials in Moscow were left to flounder. In the early 1990s, a major threat to world stability was the possibility of unintentional transfer of Soviet weapons technology. The solution has been to encourage the conversion of the former Soviet research enterprise from a defense and weapons basis to a more peaceful basis. This is being accomplished by encouraging research and development in computer science, advanced materials, and other fields of science where former Soviet researchers are internationally competitive, and by building research competence in agricultural, biomedical, and natural resource sciences, which can improve local public health, food production and resource management. It is hoped that such activities are able to raise standards of living and promote economic development.

Through the efforts of the United States government and several private foundations, a non-profit organization, the U.S. Civilian Research and Development Foundation (CRDF) was established. CRDF is funded by the National Science Foundation, the State Department and other federal agencies. The mission of CRDF is to foster and to maintain the research efforts of leading scientists in the countries of the former Soviet Union by providing them with limited research funding, modern laboratory equipment and training to support their research programs. CRDF has partnered with SRA International to provide training for scientists and research managers, both in their home countries and in the United States. SRA International members from the University of California Davis, the University of Kentucky, San Diego State University, Utah State University, the Medical University of South Carolina, the University of Liverpool, the Research Administration and Management Strategy Group, Inc., the Technology Commercialization Group, LLC and elsewhere have helped train research and technology managers from 16 Russian universities and research center directors from university institutes and independent research organizations from countries of the former Soviet Union.

In these ways, SRA International serves the global research management profession

by providing basic skills, disseminating best practices, and encouraging and enabling productive collaborative research that will increase the pace of scientific discovery by mobilizing brain power across the world, and promote the economic and social development of all parts of the world through the advance of knowledge-driven economies by skilled people.

Blending Research, Economic Development and U.S. National Security

Over the past 20 years there has been increasing recognition globally that the way university research is managed, as distinct from the research itself, can play a critical role in the success of universities and their impact on society (Kirkland, 2005). This is especially evident in the experiences we have witnessed in Africa and states of the former Soviet Union.

In a meeting sponsored by CRDF in November, 2006 in Almaty, Kazakhstan, leaders from over 20 research centers from states of the former Soviet Union were able to show how they have utilized the research equipment provided by CRDF to build their research program; two even reported that they were able to develop and license technologies based on their research. For example, a research institute in Kazakhstan has been able to develop solar panels with a much higher efficiency than what is normally achieved. This may result in a new company to produce and commercialize the panels. Another research center discussed how it has utilized research equipment for not only research purposes, but also to market its expertise and make its equipment available to industry. This center has generated over $1 million in income and is reinvesting the money to support research projects, expand laboratories, purchase new equipment and hire additional staff. The positive economic impact in these two cases could not have been possible without the equipment provided by CRDF and the training that their research scientists received in the United States and elsewhere.

Through generous donors, Nigeria has some of the latest instrumentation and technology for conducting HIV research. The training of scientists in the United States and in Europe is invaluable to these scientists as they have built collaborations. This has allowed the University of Ibadan to receive support from the NIH through subcontracts from academic institutions in the United States. The training of these investigators, their collaborations with scientists in the United States and the state-of-the-art equipment they have available for their research is having a major impact on their universities and on the next generation of graduates, and potentially will impact economic development within the country.

The examples above only highlight the types of research that are being conducted at foreign universities in some countries. However, what we discussed here is only a small portion of what is happening around the world. Research programs sponsored by the NIH are global — either through research subcontracts from U.S academic institutions or through the Fogarty International Center, which provides training opportunities in the United States for foreign nationals. The NIH also is seeking to build the research management infrastructure in countries such as India so that its research programs can be effectively and efficiently managed. The National Science Foundation (NSF) also supports international research efforts, and has sent delegations to China and elsewhere to discuss issues of research management. The research supported by these two federal sponsors adds new knowledge to the areas of research that are within the missions of the federal agencies. In addition, it is hoped that support of these research activities may lead

to new products and processes, such as the development of new pharmaceutical agents for the treatment of malaria. The ability of countries to collaborate with scientists from other areas of the world is necessary for the development of their people and for the impact education and research can have on their economy.

Looming over these very exciting and productive collaborations and initiatives, however, are questions central to the Export Control Regulations. Could the equipment and laboratories be used for nefarious purposes? Could the training received by the international researchers be applied to purposes other than those allowed? The answer to both of these questions is – Yes, but! — and this is a large "**but.**" Generally, it has been observed that knowledge and expertise that are used to gain new knowledge and applied to the health and economic welfare of people in the nations involved must be considered.

There is an undeniable need to maintain national security, both in the United States and other countries. However, it is important to balance technological innovations and knowledge expansion with societal needs and applications of that knowledge and technology. Universities and research institutions must have workable export policies and the knowledge to enforce them. Faculty must be aware of their purposes and follow the policies, and research administrators must lead efforts to provide appropriate training and ensure compliance.

Universities have always held to the "fundamental research exemption," but post 9-11 the National Science Foundation reported that the number of foreign graduate students admitted for study to the United States had declined. This has since reversed. As reported in the Chronicle of Higher Education, "to the relief of college researchers, the U.S. Commerce Department has abandoned a plan that would have restricted foreign students' and scholars' access to sensitive technology based on their countries of birth rather than their countries of citizenship or permanent residency. This is and will make a very large impact on future scientists from these countries, but from other countries as well." (Field, K. 2006).

Conclusion

We live in a world where international research collaborations are expanding nearly every day. Fundamental research provides new knowledge about the world in which we live. This knowledge may eventually find application and be translated into new products and processes. Research may lead to new ways to improve crop production to feed people, to a new understanding about disease processes and new therapies, and new products and processes that can improve a country's economy.

In this article we discussed a few examples of the positive impact from collaborations between institutions in the United States and elsewhere. The success of these programs not only aids the United States, but also has an impact on the collaborating country. Basic research collaborations and training of future scientists from less developed countries must be encouraged and supported.

While there is a need to maintain national security in the United States, an appropriate balance must be met. The dialogue must continue among agencies within the federal government that sponsor research and those that are responsible for export control regulations. Any discussion also must include leaders in academic administration, faculty, and representation from organizations such as the American

Association for the Advancement of Science, Council on Government Relations and the National Association of State and Land Grant Colleges. The appropriate balance will not only raise the economies of less developed countries, but will also aid the United States.

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