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Phase Transition in Korea-U.S. Science and Technology Relations

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Preface

This report presents an analysis of the relationship between the Republic of Korea and the United States in science and technology (S&T). The research was conducted within the Science and Technology Division of RAND. The study was supported by the Korea-U.S. Science Cooperation Center (KUSCO), and the research was conducted in close cooperation with the Science and Technology Policy Institute of Korea (STEPI). The goal of this study is to provide input to the science policy decisions of both the United States and Korean governments.

RAND Science and Technology is a division focusing on research and analysis to improve government policy decisions. Comments on this report may be transmitted to Dr. Stephen Rattien, Director, RAND Science and Technology. Comments may also be transmitted to Dr. Sungchul Chung, at the Science and Technology Policy Institute, Seoul, Korea.

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Summary

The governments of the Republic of Korea and the United States have made commitments to build a cooperative relationship in S&T that serves both political and scientific goals. The policy commitment, implemented over a 20-year period, has resulted in a strong S&T relationship. Partly as a result of this commitment, and partly due to Korea's aggressive investments into research and development (R&D) spending, Korean capacity to conduct world-class R&D now puts it among the top countries in the world. The record of its scientists publishing papers in international journals, as well as the registration of Korean patents, suggests that Korea has emerged from a pack of developing nations into the group of "scientifically advanced countries."

Both governments have made significant financial commitments to S&T cooperation. The Korean government's part in this effort has included investments in joint projects with the United States, supported by a policy of strong domestic investment in R&D. The United States government has provided both development assistance (now terminated) and special grant programs to build scientific capacity in Korea and to encourage cooperation. Thousands of Korean students have studied S&T in the United States. The result has been that, despite its relatively small size, Korea is among the U.S. government's top 20 partners in international cooperation in research and development (ICRD), and the United States is Korea's foremost ICRD partner.

The bilateral S&T relationship has grown in an environment where international S&T cooperation is growing overall: Promoting cooperation is becoming a more important part of the S&T policies of most advanced and many developing countries. The network resulting from international cooperation in science is creating a system that is transcending the actions and direct influence of individual nations, and taking on a global character. Both Korea and the United States are active partners with other countries in global science, and the bilateral relationship is being affected by the internationalization of S&T.

The enhanced scientific capacity of Korea, the changing structure of international science, and shifts in the role of the United States in it, suggest that a reexamination of the relationship is in order. Our research leads us to conclude that, while it may be fruitful to seed bilateral cooperation within policy programs, in fact, the most robust cooperation grows "from the bottom up"—

scientists linking with each other and identifying important areas of common interest and concern. Moreover, while it may be useful to continue to seek *bilateral* ties, international cooperation is more often taking on a *multinational* character. This suggests that a focus on a bilateral relationship may be too narrow: The two countries should look together at ways to link (jointly or separately) with other partners.

Opportunities for enhancing the relationship at the policy level exist but should be prioritized: International cooperation takes many forms and governments have only a limited ability to direct the flow and direction of scientific research. Governments have the most influence over large-scale "megascience" projects, such as an international high-energy physics lab. However, these projects tend to be expensive and of long duration. They require a great deal of "lobbying" to encourage investments in cooperation. Korea and the United States may wish to evaluate existing megascience activities, and discuss whether they should jointly consider (and propose) other such projects in the future.

Government policymakers also have influence over the creation and direction of distributed, organized research projects, such as the Intelligent Manufacturing Systems Project. Korea and the United States may wish to evaluate how well their joint participation in projects like these has worked, and discuss whether there are other subjects worth considering for this type of cooperative effort. These projects have the advantage over megascience projects of taking place in existing national labs and using information and communications technologies to enable collaboration. This means that less up-front investment is needed. The effort to maintain communication in a distributed collaboration, however, is more challenging than for a centrally located megascience project.

Governments have least influence over the links established by individual scientists seeking to enhance their own research activities. These projects tend to develop spontaneously from the interests of scientists themselves. Our research shows that many of these projects begin because scientists met each other face-to-face at conferences and international symposia. This would suggest that the sponsorship of joint meetings around specific subjects is a positive use of government resources when the goal is to encourage linkages at the level of the practitioner.

Both countries have "centers of excellence" that include geographically tied capabilities (such as information technology research in North Carolina) as well as intellectually driven capacities (such as Korean excellence in chemistry). Moreover, each country has made investments in scientific infrastructure that may be complementary with the capacities of the other. Mapping out these real

and virtual "centers of excellence" and comparing them to existing activities is one way to identify target areas where cooperation may be fruitful in the future. Comparing national policies in R&D funding allocation and sharing ideas about emerging areas of importance in S&T are activities that would benefit both countries.

Forging a more balanced relationship in the future will require a move toward equal participation in initiation, management, and funding of joint activities. These activities should grow out of strengths, specializations, and joint concerns, rather than an interest in building capacity. A dialogue on scientific infrastructure with a focus on sharing and leveraging expensive resources would be one way to achieve balance. Using information and communications technologies more effectively to encourage sharing of knowledge and research capacity is another way to level the playing field. A continued dialogue about effective science policy, to include governance of controversial new technologies, could serve as a leadership model for other countries. A joint effort to identify scientific goals, and then to include other scientifically advanced countries in joint projects, would help to expand the relationship in ways that benefit the S&T base of both countries.

Abbreviations

AID	Agency for International Development (U.S.)
APCTP	Asia Pacific Center for Theoretical Physics
APEC	Asia Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
ASTN	APEC Science and Technology Network
CDC	Centers for Disease Control and Prevention (U.S.)
CERN	Center for European Nuclear Research
CIS	Commonwealth of Independent States
DoC	Department of Commerce (U.S.)
DoD	Department of Defense (U.S.)
DoE	Department of Energy (U.S.)
DoI	Department of the Interior (U.S.)
DoS	Department of State (U.S.)
DVA	Department of Veterans Affairs (U.S.)
ECOTECH	APEC Economic and Technology Cooperation
EDI	Electronic Data Interchange
EPA	Environmental Protection Agency (U.S.)
ERC	Engineering Research Center
GERD	Gross Expenditures on Research and Development
GRI	Government Research Institute
GSN	Global Seismograph Network
HAN Project	Highly Advanced National Project
HHS	Department of Health and Human Services (U.S.)
HPP	High Power Processing
IBGP	International Geosphere-Biosphere Program
ICRD	International Collaboration in Research and Development
ICT	Information and Communication Technologies
IMD	International Institute of Management Development
IMF	International Monetary Fund
IMS	Intelligent Manufacturing Systems

IPR	Intellectual Property Right
ISDN	Integrated Services Digital Network
ISS	International Space Station
ISTA	International Science and Technology Agreement
ITEP	Institute for Industrial Technology Evaluation and Planning (Korea)
ITER	International Thermonuclear Experimental Reactor
KIAS	Korea Institute for Advanced Studies
KIMM	Korea Institute of Machinery and Materials
KISTEP	Korea Institute of Science and Technology Evaluation and Planning
KOSEF	Korean Science and Engineering Foundation
KOSEN	Korean Science and Engineering Network (Korea)
KSEA	Korean-American Scientists and Engineers Association
LHC	Large Hadron Collider
MIT	Massachusetts Institute of Technology
MOCIE	Ministry of Commerce, Industry and Energy (Korea)
MOST	Ministry of Science and Technology (Korea)
MOU	Memorandum of Understanding
NASA	National Aeronautics and Space Administration (U.S.)
NIE	Newly Industrialized Economy
NIH	National Institutes of Health (U.S.)
NIST	National Institute for Standards and Technology (U.S.)
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOAA	National Oceanographic and Atmospheric Administration (U.S.)
NRC	Nuclear Regulatory Commission
NSB	National Science Board
NSF	National Science Foundation
OECD	Organisation for Economic Co-operation and Development
OMB	Office of Management and Budget (U.S.)
OSTIN	Overseas Science and Technology Information Network (Korea)
PICES	North Pacific Marine Science Organization

R&D	Research and Development
RaDiUS®	Research and Development in the United States
S&E	Science and Engineering
S&T	Science and Technology
SRC	Science Research Center
STA	Science and Technology Agreement
USDA	Department of Agriculture (U.S.)
WCRP	World Climate Research Program