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March 2004

SB-1072

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MR-1248-OSTP International Cooperation in Research and Development: An Update to an Inventory of U.S. Government Spending.

ABSTRACTS

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Book-150550 Technology, Economic Growth, and Public Policy; a Rand Corporation and Brookings Institution Study. R. R. Nelson, M. J. Peck, E. D. Kalachek. 1967.

Focusing on technological knowledge as the key determinant of the rate of production and general economic progress, this study synthesizes recent data about the relation of research and innovation to economic growth. It analyzes the way in which technical advances occur, the impact of new technology on the economy, and the changes in governmental policy needed to stimulate technical advances and to make them socially productive. 251 pp. (Published by The Brookings Institution, 1967, \$6.00. Available only from booksellers or the publisher.)

MONOGRAPH/REPORTS

MR-479/1-OSTP The Decline of the U.S. Machine Tool Industry and Prospects for Its Sustainable Recovery. Vol. 1. D. Finegold, K. W. Brendley, R. J. Lempert, D. P. Henry, P. Cannon, B. Boultinghouse, M. Nelson. 1994.

At the beginning of the 1980s, the United States was the world's largest producer of machine tools and had developed a new technology—computer numerical control—that would soon revolutionize the industry. By the end of the decade, U.S. production amounted to less than half that of Japanese and German firms, and the federal government felt compelled to protect the domestic market. Despite a recent resurgence, the industry is far from recapturing lost market share. Concerned by this decline, Congress asked RAND's Critical Technologies Institute to conduct a comprehensive study of the machine-tool industry in the United States, Japan, Germany, and Italy. The study analyzes the causes of the U.S. decline and offers policy options for aiding its recovery.

MR-479/2-OSTP The Decline of the U.S. Machine Tool Industry and Prospects for Its Sustainable Recovery. Vol. 2, Appendices. D. Finegold. 1994.

This volume consists of the appendices to the machine-tool study main report, MR-479/1. Among the appendices are detailed studies of the Japanese, German, and Italian machine-tool industries; an assessment of the key current and future technologies for the machine-tool industry; and

separate case studies of two key technology areas: computer numerical control and transfer lines. This volume also includes the results of focus groups with industry experts and data problems associated with industry studies.

MR-614-OSTP The Global Positioning System: Assessing National Policies. S. Pace, G. Frost, I. Lachow, D. Frelinger, D. Fossum, D. K. Wassem, M. Pinto. 1995.

The Global Positioning System (GPS) is a military space system operated by the U.S. Air Force that continuously broadcasts precise time signals. These signals can be used worldwide to aid position location, navigation, and timing. GPS is an information resource that supports a wide range of civil, scientific, and commercial functions as well as U.S. forces. National policy toward GPS has not, however, kept pace with the system's rapidly expanding international uses. This study identifies major opportunities and vulnerabilities created by GPS for U.S. defense, commercial, and foreign policy interests, and makes recommendations for U.S. policy toward GPS, including future governance and funding. If the United States promotes GPS as a global standard, it should address the dual-use nature of the technology through international agreements. If the United States becomes an unreliable steward for GPS, it risks losing the economic and diplomatic benefits from past investments in this technology.

MR-615-RC The Potential of Nanotechnology for Molecular Manufacturing. M. Nelson, C. Shipbaugh. 1995.

Nanotechnologies are tools that measure and manipulate phenomena and objects at the nanoscale. Molecular manufacturing is the willful use of these two activities to create new objects or phenomena. The question of whether it is possible to achieve a stage in the foreseeable future when molecular manufacturing using nanotechnologies might be viable, and if so how to develop the field, is a point of contention in both scientific and policy circles. A framework for understanding the scope of this topic—possible benefits, development risks, and policy options—is presented, but it is not the intention of the authors to provide a definitive road map for future scientific and technological development; nor is it believed by the authors that such a detailed analysis would at present yield a fully credible road map given the immature nature of the field. Rather, it is the contention of this report that though important breakthroughs have been realized, much significant basic and applied research remains to be undertaken to realistically assess the far-term viability of

many of the emerging concepts. However, a careful and objective technology feasibility assessment could help stimulate near-term interim achievements of great merit while preventing technological surprises from foreign players.

Troubled Partnership: A History of U.S.-Japan Collaboration on the FS-X Fighter. M. A. Lorell. 1996.

(Published by Transaction, New Jersey, 1996. Available only from booksellers or the publisher.)

MR-682-OSTP/ED Fostering the Use of Educational Technology: Elements of a National Strategy. T. K. Glennan, A. Melmed. 1996.

The nation's most important educational goal must be to produce learners adequately prepared for life and work in the 21st century. Computer- and network-based technology will play a key role in reaching that goal. In 1983, there was about one computer for every 125 students in the nation's public schools. By 1995, there was one computer for every nine students. In 1994, U.S. schools spent about \$3 billion on computer- and network-based technology. Despite all this activity, however, examples of schoolwide use of technology are comparatively rare and isolated. This report identifies principles for guiding public officials, educators, and others concerned with increasing the use of technology to improve the performance of schools and school systems. Prepared as a result of RAND's Critical Technologies Institute (CTI) participation in federal efforts to plan a research agenda and develop a national educational technology plan, it is based upon a series of workshops, interviews, and literature reviews. This report takes stock of the current status of the use of technology by U.S. public elementary and secondary schools and suggests some of the challenges that face educators, policymakers, and producers of educational technology and software as they seek to expand and deepen the use of technology in schools.

MR-706.0-OSTP Techniques and Methods for Assessing the International Standings of U.S. Science. C. S. Wagner. 1995.

MR-707.0-OSTP Assessment of Fundamental Science Programs in the Context of the Government Performance and Results Act (GPRA). S. E. Cozzens. 1995.

MR-708.0-OSTP Economic Approaches to Measuring the Performance and Benefits of Fundamental Science. S. W. Popper. 1995.

MR-754-DHHS/ASPE/AHCPR Health Care in Transition: Technology Assessment in the Private Sector. R. A. Rettig. 1997.

Medical technology, broadly construed, embraces innovations in medicine—new drugs, biologics, medical devices, and procedures—as well as existing therapeutic and diagnostic capabilities. The evaluation of the clinical effectiveness and cost-effectiveness of medical technology, therefore, is a matter of substantial interest to many parties. "Technology assessment" (TA) is the term most often applied to such evaluation. This study examines the development of technology assessment in the private health care sector. Although it briefly addresses the hospital, physician specialty, and medical-device sectors, the report emphasizes TA in managed care organizations because they constitute the most significant change in the financing, organization, and delivery of health care. The report seeks answers to five questions: What is the demand for TA? Who performs TA? What characterizes the conduct of TA? What use is made of the results of TA? What is the role of the government? The primary conclusion of the study is that a robust analytical TA capability now exists in the managed care sector, is strongly evidence-based, and is increasingly being integrated with clinical practice guidelines in a number of organizations. Operational TA programs are now taking steps to develop cost-effectiveness analysis, which is widening the scope of TA by including the evaluation of the cost implications and effectiveness of new drugs after Food and Drug Administration approval for marketing. Several issues relating to TA that have been settled are which organizational decisions should be supported by assessments, what evaluative criteria TA should use, what routines should be used for setting priorities on which technologies are to be assessed, and at what stage medical technologies should be assessed. TA-related issues that remain to be settled are what the relationship of TA to clinical trials should be and what medical information systems should be used to integrate TA with cost and other information. Looking at the closing of governmental attempts at centralized TA programs of the 1970s and 1980s, the failure of health care reform in 1994, and the growing and thriving private-sector TA industry, the report proposes not a centralized role but a supporting role for the federal government in TA. The study is based on site visits, extensive face-to-face and telephone interviews, and examination of TA-related documents. Individuals responsible for TA and associated activities were the primary source of data. The audiences for this report include not just those with responsibilities in technology assessment, but all those policymakers and managers who are actual or prospective users of TA, including members of Congress; officials in the Departments of Health and Human Services, Veterans Affairs, and Defense; state

governments; Medicaid programs; and health insurance commissioners.

MR-839-ED Evaluating Challenge Grants for Technology in Education: A Sourcebook. S. J. Bodilly, K. J. Mitchell. 1997.

To promote the use of technology in education, the U.S. Department of Education (ED) awards Challenge Grants (i.e., matching grants) to local communities. One condition is the development and implementation of a project evaluation plan to measure the project's success. At ED's request, RAND prepared this sourcebook to help project managers and evaluators design an evaluation that would (1) delineate and communicate expectations and key milestones; (2) provide regular feedback to project leaders and other participants; (3) document project outcomes and lessons learned; and (4) provide an account to funders and stakeholders. RAND proposes that documentation of projects take the form of a Progress Portfolio. This report describes the form and purposes of such a portfolio, furnishes sample worksheets, and gives a detailed hypothetical example. The methods and issues discussed in this report should be of interest to anyone responsible for the successful completion or evaluation of a large-scale developmental project embedded in a reform-type effort.

MR-855-OSTP Linking Sustainable Community Activities to Pollution Prevention: A Sourcebook. B. E. Lachman. 1997.

This report provides an introduction to sustainable community activities and ways in which supporters of pollution prevention can take advantage of such efforts. A "sustainable community" effort consists of a long-term integrated and systems approach to developing and achieving a healthy community by addressing economic, environmental and social issues. Fostering a strong sense of community and building partnerships among key stakeholders are also important elements of such efforts. This report discusses how hundreds of communities across the United States are taking "sustainable community" approaches to deal with their most pressing problems. Such approaches have been applied to issues as varied as urban sprawl, inner-city and brownfield redevelopment, new economic development, a strong local economy, environmental justice, ecosystem management, agriculture, biodiversity, green buildings, energy conservation, watershed management, and pollution prevention. This report explains such activities by examining the process of developing a sustainable community initiative, describing sources of support, and presenting detailed community examples. Then, it explores the relationship between sustainable community activities and pollution prevention. The author includes an extensive annotated bibliography giving points of contact

with phone numbers, web page addresses, and published documents about sustainable community activities throughout the United States.

MR-864-OSTP The Cosmos on a Shoestring: Small Spacecraft for Space and Earth Science. L. Sarsfield. 1998.

Small spacecraft have become popular for a number of reasons, most prominently the needs to reduce overall cost, be built more quickly, and spread mission risks. NASA has been challenged with crafting a program that continues to produce meaningful science within the constraints of the available budget. Still, pound for pound, small spacecraft are not precisely inexpensive, given the effects of complexity, launch costs, and a greater degree of risk. Historically, science spacecraft have demonstrated increasing reliability, but this trend might not continue, given the shift to managed risk. There is generally less money available to smaller programs to test spacecraft functions and operational procedures prior to launch. Small spacecraft are also generally less robust. Efforts to reduce failure potentials through the application of more reliable components, better testing, and advanced design techniques should receive greater attention. Despite the risks, however, small spacecraft fulfill important roles in earth science, astrophysics, space physics, and planetary science. NASA's current generation of small spacecraft is capable of impressive levels of performance.

MR-871-OSTP Surplus Federal Computers for Schools: An Assessment of the Early Implementation of E.O. 12999. T. K. Glennan, W. S. Baer, S. W. Purnell, G. Farnsworth, G. L. Schuyler. 1997.

In April 1996, President Clinton signed an executive order (E.O.) intended to promote transfer of unneeded federal government computer equipment to schools and educational nonprofit organizations. The federal government owns about 2 million personal computers, and approximately 100,000 operable computers become surplus each year. In the first year of implementation, 30,000 to 50,000 computers were donated to schools, many of which were not in operating condition. Private-sector experience suggests that use of specialized organizations to upgrade and refurbish computers can increase the number of operable and useful computers substantially. About 60 agencies have developed implementation plans, some of which build on existing programs. Agencies with the most computers are concerned with how the E.O. will affect existing programs. Almost all program leaders feel that the program is not a high priority at upper agency levels, especially since no funds are authorized for carrying out the order. Concerns also exist about identifying appropriate recipients, delivery to recipients, and how to upgrade and repair equipment. To address all these

concerns, the authors draw on the successful donation experiences of established federal programs and the public sector to make recommendations for continuing implementation.

MR-900-OSTP International Cooperation in Research and Development: An Inventory of U.S. Government Spending and a Framework for Measuring Benefits. C. S. Wagner. 1997.

The United States spends considerable sums on international cooperation in research and development (ICRD). Policymakers have expressed concerns about these cooperative activities. Some fear that the United States is paying more than its fair share of the work's cost. Others worry that the country is giving away critical technologies to potential foreign competitors. Additional concerns have been voiced that cooperative programs subordinate the interests of true science to strategic or political ends. These claims are difficult to test, however, for a number of reasons: the large number of projects; the long timelines of projects; and the focus on reporting research results, not measuring larger benefits. This report uses information from the RAND RaDiUS research and development (R&D) database, complemented by agency interviews, to catalogue international cooperative R&D and to construct a framework for assessing benefits the United States may derive from participation in such research. Based on the framework of metrics developed for this project, the author also presents a case study examining cooperation in earthquake sciences and seismology to test the ability of these metrics to provide feedback on benefits.

MR-965-OSTP/FinCEN Cyberpayments and Money Laundering: Problems and Promise. R. C. Molander, D. Mussington, P. Wilson. 1998.

At the request of the Financial Crimes Enforcement Network (FinCEN), an agency of the U.S. Department of the Treasury, RAND conducted and analyzed a strategic decisionmaking exercise to examine money laundering concerns raised by the deployment of cyberpayment systems. Participants in the exercise represented the Executive Branch, the cyberpayment and banking industries, Congress, and academia. The tasks of the exercise were to (1) describe current cyberpayment concepts and systems; (2) identify an initial set of cyberpayment characteristics of particular concern to law enforcement and payment system regulators; (3) identify major issues cyberpayment policies will need to address; and (4) array appropriate recommendations to address potential system abuse in a set of proposed action plans. While it is premature to draft a comprehensive regulatory regime for cyberpayment products, participants agreed that prompt collaborative action by industry and government—and among governments—is needed.

Dialogue on standards, regulatory transparency, and vigorous surveillance can prevent the criminal exploitation of cyberpayment system vulnerabilities.

MR-972-OSTP International Agreements on Cooperation in Remote Sensing and Earth Observation. C. S. Wagner. 1998.

As of the end of 1997, the United States had cooperative agreements with 76 countries and six multinational organizations covering the operations of 32 active satellites, most often covering the collection of weather data. These agreements are entered into by a number of agencies, with five agencies accounting for 90 percent of the agreements identified for this project: the National Oceanic and Atmospheric Administration, the U.S. Air Force, the Defense Mapping Agency, the U.S. Geological Survey, the National Aeronautics and Space Administration, and the U.S. Forest Service. This report catalogs the agreements and assesses the extent of interagency coordination that take place when agreements are negotiated and signed. Three possible policy actions emerged: rationalizing the terms of and descriptions for international agreements across agencies; creating a central clearinghouse for information on agreements, perhaps using the World Wide Web; and streamlining the available formal coordination process to increase the frequency of its use.

MR-974-OSTP Monitoring for Fine Particulate Matter. E. Eiseman. 1998.

Particulate matter (PM)—dust, dirt, smoke, soot, and liquid droplets—comes from a variety of sources and is a mixture of many pollutants made up of several different chemical species. Recent evidence about health effects and the fundamental physical and chemical differences between fine and coarse PM prompted the EPA to set new standards. Monitoring to determine whether an area has met these standards requires a comprehensive approach that combines analytical techniques to assess mass and chemical composition with an integrated network of ambient and source PM monitors. However, chemical analysis of PM is costly and difficult, and existing technologies are not capable of continuous sampling and monitoring for chemical composition. Therefore, the next generation of PM monitors should be multifunctional instruments capable of continuous, real-time monitoring of both PM mass and chemical composition. In addition, they will need to address several barriers to their use, including cost, complicated calibration and verification systems, and cumbersome installation and maintenance procedures.

MR-976-OSTP The Cyber-Posture of the National Information Infrastructure. W. H. Ware. 1998.

This report discusses the vulnerability of the nation's information infrastructure to external attacks and other kinds of disruptions. It assesses the extent of the data available for measuring this threat and concludes that energy supplies, telecommunications, and computer-based systems should be of first priority for attention and remedial action. Finally, it suggests steps to reduce national vulnerability. The information security posture in both government and the private sector needs immediate examination and attention. Analytic studies should be performed to establish such infrastructure features as sources of resilience and the characterization of normalcy, and to specify R&D requirements. In addition, the nation should establish a warning mechanism and a supporting coordination center.

MR-979-OSTP Monitoring and Controlling the International Transfer of Technology. J. Bonomo, J. Lowell, J. Pinder, K. W. Webb, J. Saul, P. Cannon, J. Sloan, D. M. Adamson. 1998

The United States is a net exporter of technology and technical knowledge. Despite fears that this outflow of technology is costly to U.S. taxpayers, it would be impractical to institute a government-wide system for monitoring and restricting overseas technology transfers. First, a review of the economic effects of technology transfer showed that it is not possible to estimate accurately the financial effect on the United States of the international transfer of government-sponsored technology. Moreover, the methods of transfer that might be monitored or restricted are also sources of the valuable, high domestic societal return to government investments in research and development. Finally, government agencies do not see international technology transfer issues as central to their missions and are likely to see new requirements as constraints on their ability to carry out their missions. The authors thus recommend no major policy shifts but do suggest some changes in existing policy that would enhance the U.S. government's ability to trace and to capture the benefits of certain technical innovations.

MR-1005-OSTP/FinCEN Exploring Money Laundering Vulnerabilities Through Emerging Cyberspace Technologies: A Caribbean-Based Exercise. D. Mussington, P. Wilson, R. C. Molander. 1998.

How should nations and financial institutions begin to address the thorny problems posed by the vulnerability of cyberpayments, Internet banking, and Internet gambling to abuse by money launderers and other perpetrators of financial crime? Which questions need to be asked so that law enforcement agencies from different nations can begin to cooperate without stifling the positive aspects of the frontierless world of Internet finance? This report outlines the first steps in an emerging international dialogue on the

promise and potential problems of cyberspace as an economic environment. It summarizes research performed by RAND for the Financial Crimes Enforcement Network of the U.S. Department of the Treasury. This research was done in concert with the ongoing efforts of the Caribbean Financial Action Task Force and the Commonwealth Secretariat as part of an international undertaking to examine financial crime concerns, particularly as they relate to the Caribbean.

MR-1005/1-OSTP/FinCEN Explorando Las Vulnerabilidades Del Lavado Del Dinero Por Medio De Las Tecnologías Emergentes Del Ciberespacio: Un Ejercicio De Base Caribeno. D. Mussington, P. Wilson, R. C. Molander. 1998.

How should nations and financial institutions begin to address the thorny problems posed by the vulnerability of cyberpayments, Internet banking, and Internet gambling to abuse by money launderers and other perpetrators of financial crime? Which questions need to be asked so that law enforcement agencies from different nations can begin to cooperate without stifling the positive aspects of the frontierless world of Internet finance? This report outlines the first steps in an emerging international dialogue on the promise and potential problems of cyberspace as an economic environment. It summarizes research performed by RAND for the Financial Crimes Enforcement Network of the U.S. Department of the Treasury. This research was done in concert with the ongoing efforts of the Caribbean Financial Action Task Force and the Commonwealth Secretariat as part of an international undertaking to examine financial crime concerns, particularly as they relate to the Caribbean.

MR-1008-1-OSTP New Forces at Work: Industry Views Critical Technologies. S. W. Popper, C. S. Wagner, E. V. Larson. 1998.

As part of the effort to produce the fourth National Critical Technologies Report, the Office of Science and Technology Policy in the Executive Office of the President asked a research team from RAND's Critical Technologies Institute, now named Science and Technology Policy Institute, to engage business and industry leaders explicitly in a discussion of the issue of critical technologies by gathering private-sector views on what technologies are appropriate to consider under this rubric—and why. The primary substantive input was elicited through extended, detailed interviews conducted individually, usually with one firm's senior executive per session, on-site in most cases. The report presents and analyzes interviewees' responses to what technologies they consider to be critical to their firm or industry; explores the question of what "critical technology" means; reports interviewees' assessments of the status of U.S. efforts and performance in the areas of technology they deemed

critical; considers the respective roles of industry, universities, and government in contributing to and sustaining the U.S. technology base; suggests a process whereby the dialogue between government and industry on the public policy issues relating to technology might be made more integral and informative to the activities of both. The responses of many of the interviewees emphasized the aspect of technology as process over technology as product. In line with this vision, the authors propose a critical-technologies review process that would enable wider, more meaningful, and ongoing communication among industry, government, and universities on technology issues.

MR-1011-DOC The Machine That Could: PNGV, a Government-Industry Partnership. R. M. Chapman. 1998.

In 1993, amid concerns that the U.S. auto industry was losing ground to Japanese competitors, the federal government and the Big Three U.S. automakers (Ford, Chrysler, and General Motors) entered into a unique alliance: the Partnership for a New Generation of Vehicles (PNGV). The PNGV, which also involves universities, suppliers, and other participants, arose from the belief that providing industry with access to technologies generated by federally supported research would allow automakers to develop a high-efficiency, environmentally friendly car—attaining up to 80 miles per gallon—that would still match or surpass today's vehicles in performance, cost, and safety. In its launch phase, the PNGV faced considerable skepticism, as well as stiff political and organizational challenges. This report tells the story of the program's beginnings, how it has dealt with these challenges, and its progress to date, which, as of 1998, remains ahead of schedule. It also details lessons that may be useful to managers of similar partnerships in the future. The author was the government's first technical manager of the PNGV. His account was developed from notes, recollections, and interviews with former colleagues.

MR-1248-OSTP International Cooperation in Research and Development: An Update to an Inventory of U.S. Government Spending. C. S. Wagner, A. Yezril, S. Hassell. 2001.

Scientific research is becoming increasingly more globalized and more collaborative. At the same time, there is growing pressure within the United States to justify government funding for science and technology (S&T). The potential conflict between these developments raises questions of whether U.S. investment in S&T benefits U.S. taxpayers and whether investment in scientific capacity building overseas has created competition rather than mere assistance. To understand the answers to these questions, this report describes the scope and nature of U.S. spending on international cooperative research and

development (ICRD) in fiscal year (FY) 1997. Most spending (over 90 percent) is for collaboration on common research problems among scientists from different countries. Aerospace S&T dominated spending, with biomedical science a distant second. This book finds that the federal government spent \$4.4 billion on ICRD in FY 1997, an increase of \$1.1 billion over FY 1995. However, this figure may reflect better data collection and increased reporting, rather than an actual increase in spending. The only notable change in the two-year period involves a substantial increase in cooperative activity with Russia, tied heavily to space-related projects.

MR-1259-OSTP Concepts for Enhancing Critical Infrastructure Protection: Relating Y2K to CIP Research and Development. D. Mussington. 2002.

Spending by the U.S. government and industry on activities to prevent the predicted year 2000 (Y2K) crisis amounted to approximately \$100 billion, and other global spending may have been even greater. Debate continues over whether this massive effort precluded catastrophic system failures or the fears were overstated to begin with. This report presents the findings of a RAND study that attempted to shed light on this debate by addressing the following questions: What kind of event was the Y2K "crisis"? Was the massive and costly remediation effort justified? What lessons does the Y2K experience offer for critical infrastructure protection (CIP)? What do these lessons imply for federal CIP research priorities? The study included a literature review, interviews with government and industry computer experts, and a workshop involving participants in Y2K remediation efforts from industry and government. The report summarizes the workshop activities and synthesizes the key conclusions from all the project activities. It is concluded that new R&D approaches are required to deal with complex and adaptive settings. Vulnerabilities resulting from system complexity are expanding at a much faster pace than our means of understanding them. At the same time, exploitation of infrastructure vulnerabilities for criminal, terrorist, or foreign adversary purposes is a threat that potentially has no boundaries. To make CIP more manageable, research is needed that provides real data and models for understanding highly complex and uncertainty-laden environments. Such research should be a high federal priority and should be pursued aggressively.

MR-1324-OSTP New Forces at Work in Mining: Industry Views of Critical Technologies. D. J. Peterson, T. LaTourrette, J. T. Bartis. 2001.

The results of a series of in-depth discussions with leading representatives of 58 mining and quarrying firms, equipment manufacturers, research institutions, and other organizations selected for their prominent position in the industry and their ability to think broadly about

technology trends. The industry representatives identified a fairly consistent set of priority areas critical to the success of the industry today and out to 2020. These trends include adoption of information technologies such as sensors, wireless communications, and positioning systems for real-time monitoring and optimization of mining operations and equipment; the use of information and communications technologies to more closely integrate mine operations; improved maintenance technologies and practices; and gradual implementation of technologies for operator assistance, remote control, and automation. The discussions highlighted the importance of collaborative technology research, development, and implementation strategies and the increasingly critical role of mine personnel in the utilization of new technologies.

MR-1341.0-COSC The Effects of the Soledad Canyon Mine on the Aggregate Industry in the Greater Los Angeles Metropolitan Area. L. S. Dixon, T. LaTourrette. 2001.

This report estimates the likely effects of a proposed sand and gravel (aggregate) mine in Soledad Canyon, just east of the City of Santa Clarita in Los Angeles County. An economic model is used to predict the likely effects of the proposed mine on the price of aggregate, the costs of transporting aggregate, and amount of aggregate reserves in the greater Los Angeles metropolitan area. The study concludes that the proposed mine would reduce transportation costs by between \$24 million and \$61 million between 2003 and 2027, or between 0.9 and 1.8 percent. These transportation cost savings represent savings to society as a whole. The study finds that the proposed project may either increase or reduce the economic profits of the region_p1_ss mining industry and would lower the price of aggregate in the region by between 0.2 and 2.2 percent on average over time (or from roughly \$10.00 per ton to between \$9.80 and \$9.98 per ton). The results of this study must be assessed in combination with estimates of the other costs and benefits associated with the project in deciding whether or not to proceed with the project.

MR-1504-OSTP U.S. Government Funding for Science and Technology Cooperation with Russia. C. S. Wagner, I. T. Brahmakulam, D. J. Peterson, L. Staheli, A. Wong. 2002.

The U.S. government spent, on average, \$300 million a year during the 1990s to support science and technology (S&T) cooperation with Russia. This document details U.S. government spending on cooperative S&T activities with Russian partners. RAND collected and analyzed data at the project level and surveyed agency officials about specific projects and programs. These data were aggregated by spending into categories created by RAND. The report thus provides an analytic, cross-agency

overview, presenting a broad picture of the U.S.-Russia S&T relationship between 1994 and 2000. The U.S. government's projects with Russia have a slightly different pattern than can be observed with other scientifically advanced countries: They are more binational in character, less collaborative, more technology-based, less of a shared effort, and dominated more by spending in aerospace applications. Reports from scientists working with Russian counterparts indicate that the United States is gaining significant scientific benefit from this joint collaboration. Although funding for the U.S.-Russia S&T relationship seems to have dropped in 2001, there has been a revived interest within the U.S. scientific community in working with Russia and an increase in the number of projects being considered.

MR-1608-OSTP Alternatives for Landmine Detection. J. MacDonald, J. R. Lockwood, J. McFee, T. Altshuler, T. Broach, L. Carin, R. S. Harmon, C. Rappaport, W. R. Scott, R. Weaver. 2003.

At the rate that government and nongovernmental organizations are clearing landmines, it will take 450–500 years to rid the world of them—and that's just if no more are placed. Concerned about the slow pace of demining, the Office of Science and Technology asked RAND to assess potential innovative technologies being explored and to project what type of funding would be required to foster the development of the more promising ones. As all landmine detection methods have strengths and weaknesses in different environments, the authors suggest that the federal government undertake a research and development effort to develop a multisensor mine detection system over the next five to eight years. The system would be based on the algorithmic fusion of data of many sensors, and research generated from this integration could eventually be applied to other sciences as well. Using multiple technologies to locate landmines would result in fewer casualties worldwide and may help restore stability to postconflict regions. In addition to the main report, this book includes 23 papers, written by leading specialists, that individually probe the latest technologies in landmine detection.

MR-1644-ROK Phase Transition in Korea-U.S. Science and Technology Relations. C. S. Wagner, A. Wong, S. Lee, I. T. Brahmakulam. 2003.

The governments of the Republic of Korea and the United States over the past 40 years have made commitments to build a cooperative relationship in S&T that serves both political and scientific goals. The policy commitment 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. Both

governments have made significant financial commitments to bilateral 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 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. This shift in the gravity centers of science has implications for the bilateral relationship as well as Korea's and the United States' relationship with other countries. 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. The most robust cooperation grows from the "bottom up"-scientists linking with each other and identifying important areas of common interest and concern and this should be considered as the focus of the Korea-U.S. relationship. More importantly, 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. A review of complementarities may also identify important areas where the two countries should work together.

MR-1707-NETL New Forces at Work in Refining: Industry Views of Critical Business and Operations Trends. D. J. Peterson, S. Mahnovski. 2003.

Reports the results of discussions with representatives of refining firms, technologies and services providers, research institutions, and other organizations on current and future trends in the U.S. refining industry. Discussants were generally optimistic about the future of the industry but were concerned about the effects of environmental regulations. They recommended that the Department of Energy assume a more prominent policy role on refining and fuels issues.

TECHNICAL REPORT

TR-136-OSTP High-Technology Manufacturing and U.S. Competitiveness: Is U.S. High-Technology

Manufacturing at Risk? C. T. Kelley, M. Wang, G. Bitko, M. S. Chase, A. Kofner, J. Lowell, J. C. Mulvenon, D. S. Ortiz, K. Pollpeter. 2004.

In response to the concern that an increasing amount of high-technology manufacturing formerly performed in the United States is now being done overseas, the Office of Science and Technology Policy asked the RAND Corporation to provide analytic support to the President's Council of Advisors on Science and Technology. The support included a description of past and current trends of U.S. high-tech manufacturing, a theoretical and empirical economic analysis of traditional and high-tech manufacturing, and an analysis of U.S. research and development statistics and of trends in choices of academic disciplines.

ISSUE PAPERS

IP-178 E-Mail Communication Between Government and Citizens: Security, Policy Issues, and Next Steps. C. R. Neu, R. H. Anderson, T. K. Bikson. 1998.

IP-203 Information Technology in the Home: Barriers, Opportunities, and Research Directions. R. Lewis. 2000.

IP-241-OSTP Is There a Shortage of Scientists and Engineers: How Would We Know? W. P. Butz, G. A. Bloom, M. E. Gross, T. K. Kelly, A. Kofner, H. E. Rippen. 2003.

Numerous alarms have been sounded about looming shortages of scientists and engineers in the United States. To more closely examine this issue, the authors focus on the production of science and engineering PhDs. They identify and discuss five concepts of shortage. Production can be called low if: (1) it is lower now than it was in the past, (2) competitors' share of total production is growing, (3) it is lower than what people doing the producing would like, (4) less is being produced than the nation is deemed to need, and (5) it is not meeting market demand.

REPRINTS

RP-399 The Mediterranean Environment: Prospects for Cooperation to Solve the Problems of the 1990s. R. J. Lempert, G. Farnsworth. 1995.

Nearly 70 environmental treaties have been signed during the last 20 years. They include major agreements designed to protect the ozone layer, to limit climate change, and to control the transport of hazardous waste. However,

important questions remain concerning the effectiveness of these treaties and of international environmental organizations in achieving their objectives. This article constitutes a case study of the Mediterranean region and seeks to determine whether efforts to mobilize international environmental cooperation among widely differing nations have been effective and to see how successfully any agreements have been implemented. Originally published in *Mediterranean Quarterly*, v. 5, no. 4, Fall 1994.

RP-417 Technology for a Sustainable Future, Ideas: A Summary of Workshop Discussions. B. E. Lachman, R. J. Lempert, S. A. Resetar, T. Anderson. 1995.

Originally published in *Proceedings of White House Conference on Environmental Technology*, Dec. 1994.

RP-543 Satellite Navigation-Aiding for Ballistic and Cruise Missiles. G. Frost, I. Lachow. 1996.

The proliferation of ballistic and cruise missiles to Third World countries is becoming a major concern for both the United States and the Russian Federation. These classes of missiles can carry weapons of mass destruction and are difficult to intercept. To date, this concern has been somewhat mitigated because these missiles are relatively inaccurate. But the potential of improving the accuracy of these missiles by using the Global Positioning System (GPS) or the Global Navigation Satellite System (GLONASS) makes them a greater threat. This paper evaluates the error sources that affect missile accuracy and assesses the improvement that could occur by using satellite navigation-aiding of the missile's inertial guidance system. The authors' analysis focuses on the U.S. GPS system; however, the findings would be similar if GLONASS were used. The paper concludes that satellite navigation-aiding can improve the accuracy of current short- and medium-range ballistic missiles by approximately 20–25 percent, and up to 70 percent for advanced ballistic missiles. It can also greatly improve the accuracy of cruise missiles with ranges greater than 50 km. In addition, the U.S. policy of Selective Availability has a marginal effect on controlling missile accuracy in most of the cases the authors examined. Originally published in *5th International Conference on Differential Satellite Navigation Systems*, St. Petersburg, Russia, May 20–24, 1996.

RP-630 Roles and Impacts of RAND in the Pre-Apollo Space Program of the United States. B. W. Augenstein. 1997.

RAND, in Santa Monica, California, performed a seminal function in the early years of the U.S. Space Program, not only in landmark science, technology, and operational/programmatic studies which helped to shape

U.S. endeavors in space, but also by the diffusion of key study participants into industry and government, where they helped reach many of the initial goals set. The salient RAND work now declassified is described here from the viewpoint of a deeply involved participant. Where possible, this work is discussed in the context of Former Soviet Union activities. Originally published in *International Astronautical Federation, 46th International Astronautical Congress*, October 2–6, 1995, Oslo, Norway.

RP-642 Beyond Command and Control: An Evolution Is Occurring in State and Local Government Environmental Activities. B. E. Lachman. 1997.

State and local governments are implementing many innovative activities to improve environmental performance and to lower the cost of compliance. These activities include regulatory experiments and voluntary programs in partnership with many different stakeholders and in a wide range of environmental approaches and activities. State and local pollution prevention (P2) voluntary programs, technical assistance activities, and state P2 planning laws are helping businesses save money and reduce the amount of pollution that they generate. Innovative facility and multimedia permitting and inspection programs are also being implemented to improve environmental performance and/or reduce the regulatory burden on industry. EPA and the states have jointly developed the National Environmental Performance Partnership System (NEPPS), which allows for more state priority setting and innovation in implementing EPA delegated programs. States have also started developing initiatives to promote regulatory innovation by encouraging and rewarding exceptional environmental management and environmental leadership, such as exploring the regulatory implications of ISO 14000. Regional, state, and local government sustainable community, ecosystem management, watershed management, and other place-based management approaches are another type of innovative approach designed to improve environmental performance. Such state and local activities are helping to transform U.S. environmental policy. A byproduct of such activities is a fledgling two-track regulatory system, where more proactive and environmentally responsible businesses receive preferred treatment from regulators because they have demonstrated their commitment to the environment. This paper briefly overviews some of these innovative activities and explores how these activities are helping to create a two-track regulatory system. It concludes by briefly discussing whether such state and local activities can help facilitate an evolution beyond our current command and control regulatory system. Reprinted from *Air and Waste Management Association's 90th Annual*

Meeting and Exhibition, June 8–13, 1997, Toronto, Ontario, Canada.

RP-685 Will the Internet Transform Higher Education? W. S. Baer. 1998.

Originally published in *The Emerging Internet*.

RP-740 Global Positioning System: Market Projections and Trends in the Newest Global Information Utility. S. Pace, J. E. Wilson. 1998.

The Global Positioning System (GPS) is a space-based signal providing precise timing, location, and velocity information. Just as any number of receivers can tune into a commercial TV or radio station, there is no limit on the number of people who can use GPS. With equipment ranging from small, hand-held receivers to large, rack-mounted electronics, anyone, anywhere, at any time can use the GPS signal. Initially, GPS applications were used for national defense; these remain in place today. The GPS signal has also become important commercially, from electric power distribution to land survey, car navigation, and management of telecommunications networks. In sponsoring this study, the U.S. Department of Commerce's Office of Telecommunications provides a current view of the commercial status and trends of the industry since its availability for civilian use in 1984, projects its development over the coming years, and identifies factors that will affect the growth of commercial GPS markets. Originally published in project report prepared for the International Trade Administration, Office of Telecommunications, U.S. Department of Commerce.

TESTIMONY

CT-112 The Regulation of Commercial Remote Sensing Systems. S. Pace. 1994.

This testimony provides a review of U.S. government regulation of commercial remote sensing systems, such as export controls and operating licenses. Proceeding from the 1992 Land Remote Sensing Act, the testimony argues that U.S. national security and economic interests would be best served by continuing to limit the export of remote sensing technologies and systems save in exceptional circumstances while promoting the operation of private remote sensing systems subject to U.S. jurisdiction.

CT-139 Promoting Commercial Space Activity. S. Pace. 1996.

CT-145 Elements of a National Security Strategy to Foster Effective Use of Technology in Elementary and Secondary Education. T. K. Glennan. 1998.

This testimony reviews the findings of RAND/MR-682-OSTEP/ED, *Fostering the Use of Educational Technology: Elements of a National Strategy*. Mr. Glennan specifically proposes that the federal government create an institute, outside of the government itself, to help plan, guide, and synthesize assessments of the use of educational technology.

CT-146 International Cooperation in Research and Development. C. S. Wagner. 1998.

PAPERS

P-7836 Remote Sensing and Global Competitiveness. S. Pace. 1993.

These remarks were given at the First Annual Symposium on Coupling Technology to National Needs as part of a panel on "Visualization and Communication: Overhead Imagery." Based on the author's involvement with remote sensing policy while at the Department of Commerce from 1990 to 1993, the paper provides a brief overview of U.S. policy and legislation affecting remote sensing, discusses recent developments, and identifies continuing issues for commercial ventures. Sample issues include operating licenses, export controls, government as a customer, and strategic partnerships.

P-7965 National Environmental Technology Strategy: Residential Construction Workshop, October 1994. T. Anderson, B. E. Lachman. 1996.

P-7966 Sustainable Food Production Workshop, Policy Options to Promote Environmental Technologies. B. E. Lachman. 1996.

DOCUMENTED BRIEFINGS

DB-222-OSTP Computer Donations to Schools: A Review of Selected Private-Sector, Nonprofit and State Programs. W. S. Baer, G. Farnsworth. 1997.

This documented briefing discusses private-sector, nonprofit and state-sponsored programs that transfer used computer equipment to elementary and secondary schools. There are literally thousands of such programs in the United States, which in total provide more than 100,000 computers annually, or roughly 10 percent of all the

computers acquired by K-12 schools. Until recently, most gifts have involved a direct transfer between an individual or corporate donor and a school recipient. Donors have found, however, that schools need considerable support to properly install, maintain and operate the donated computers. This has led in some cases to unanticipated repair and administrative costs to donors or, in other cases, to less-than-expected goodwill from their donations. For their part, educators all too often report that donated equipment is obsolete, arrives broken or is missing crucial components such as keyboards or disk drives. Such donations are usually discarded, although they sometimes are useful for training vocational students in basic computer repair. These problems have encouraged many private firms to donate used equipment through third-party, computer recycling or intermediary organizations. Current recycling programs emphasize refurbishing and upgrading computers that can run multimedia software and access the Internet. Recycling programs are certainly not the full solution to schools' technology needs, but if properly managed, they can add substantially to the number of capable computers in elementary and secondary school classrooms.

DB-247-NASA/OSTP Data Policy Issues and Barriers to Using Commercial Resources for Mission to Planet Earth. S. Pace, B. Sponberg, M. K. Macauley. 1999.

The United States is pursuing several major initiatives aimed at characterizing and understanding the interactions between localities and global change in the environment. The largest single effort in this research is NASA's Mission to Planet Earth and a planned system of satellites and ground networks known as the Earth Observation System. This RAND study assesses the data policy issues and barriers to using commercial resources to support the objectives of this program. Its main objectives were to provide an overview of U.S. and international data policy issues affecting remote sensing data, to identify potential data policy barriers to the use of commercial remote sensing data in NASA's program, and to provide recommendations on how NASA and private industry may be able to reduce barriers to the use of commercial remote sensing to meet the needs of NASA and broader U.S. policy objectives.

DB-316-NASA/OSTP The Earth Below: Purchasing Science Data and the Role of Public-Private Partnerships. S. Pace, D. Frelinger, B. E. Lachman, A. C. Brooks, M. D. Gabriele. 2000.

The Science Data Purchase Program, commonly known as the Science Data Buy (SDB), has been a success in supplying commercial remote sensing data that serves NASA science requirements, but plans for its continuation are uncertain. Although NASA has said that it will

purchase science data when it is cost-effective to do so, rather than build new satellites, there is little guidance on determining cost effectiveness. This study was organized to examine public-private partnerships in remote sensing, metrics for evaluating such partnerships, the types of partnerships that might be most appropriate for NASA's Earth Science Enterprise, and options for the future of NASA's SDB. The authors conclude that the "data clearinghouse" is likely to be the most appropriate partnership model for acquiring, maintaining, and distributing data from many sources to many different users. The authors caution that NASA needs to understand and choose what kind of buyer of private remote sensing data it wants to be before it develops specific cost-effectiveness metrics, and that it should clearly articulate the role of the SDB with respect to an overall strategy for earth science research.

DB-345-OSTP Linking Effectively: Learning Lessons from Successful Collaboration in Science and Technology. C. S. Wagner, L. Staheli, R. S. Silberglitt, A. Wong, J. B. Kadtko. 2002.

Creating international linkages in science and technology (S&T) can benefit many of the parties involved. Political and scientific benefits are often intertwined. This report has three goals in studying the efficiency and effectiveness of government-sponsored collaboration: (1) to improve understanding of the dynamics of international collaboration in S&T, (2) to provide tools for policymakers seeking to improve the effectiveness and efficiency of collaboration, and (3) to coordinate with analysts conducting similar studies in different countries. This report draws lessons from four case studies and further presents key questions that emerged to be used as a guide for those seeking to formulate similar collaborative programs. The authors find that distributed research is an effective form of collaboration and that national benefits include goodwill and access to key resources.

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It is a common perception that education in the United States is in severe trouble. Technology, particularly educational technology (EdTech), has been put forth as a solution to this and the attendant social ills. This belief, and the resulting policies focusing on EdTech, have given educational technologists a significant chance to help improve education. However, this chance comes with extremely high costs of failure. Policy makers must understand when EdTech works, and for whom, in order to make funding decisions. Answering this question requires evaluation. Evaluating EdTech is particularly difficult, however, because implementing a technology-based curriculum often involves many structural, institutional, and curricular reforms. This multitude of changes make it difficult to recognize what worked and why. One way around this problem has been to employ laboratory-based experimental methods. As is shown in this paper, these evaluations have revealed a great deal about the efficacy of EdTech in specific situations. However, laboratory-based methods do not address all of the difficulties with evaluation. Addressing the other difficulties will require that future research focus less on the particular EdTech

itself, and more on its interactions with students, teachers and institutions.

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