

Tapping into Asia's Successful R&D

FEATURE

by Mike May

亞洲研究與發展

If current R&D trends continue throughout the world, Asia could dominate the future of science and technology. In fact, some Asian countries already rank as world leaders in many technological arenas, from automobiles to optoelectronics. Asian countries are taking the lead in scientific and technological capabilities through a simple strategy—buying their way to the top with enormous investments in R&D. Many physics-based companies worldwide are enjoying the largesse of this buying spree.

During fiscal year 1996, Japan will increase its federal science and technology budget by 6.9%—the highest percentage increase since 1979—to \$26.7 billion. In addition, Japan's Council for Science and Technology, a government advisory committee headed by the prime minister, recently called for an additional \$170 billion in government spending on science and technology over the next five years. Japan's current government support, however, represents only about one-quarter of Japan's total R&D spending, and the remaining three-quarters comes from the private sector. According to Mindy Kotler, director of the Japan Information Access Project in Washington, D.C., "Japan plans to increase its civilian R&D spending to twice that in the United States by the year 2000, assuming that current funding policies continue in both countries." Beyond all of this R&D spending, the Japanese government backs loans and offers tax deductions for expenses on experimental science and technology.

South Korea has been increasing its science and technology budget by 15% per year since 1980, and it will spend \$1.1 billion on nondefense R&D in 1996. Private-sector R&D spending in South Korea has increased even more—about 20% per year. As a result of these public and private increases, South Korea's total investment in R&D soared from \$418 million in 1981 to more than \$5.4 billion in 1995 (see "Physics in Korean Industry," page 26).

R&D investment in Taiwan was about \$4.5 billion, or 2.06% of GNP, in 1994, and is expected to be 2.20% of GNP this year. Likewise, China plans to triple its spending on science and technology by the year 2000.

Asian expertise

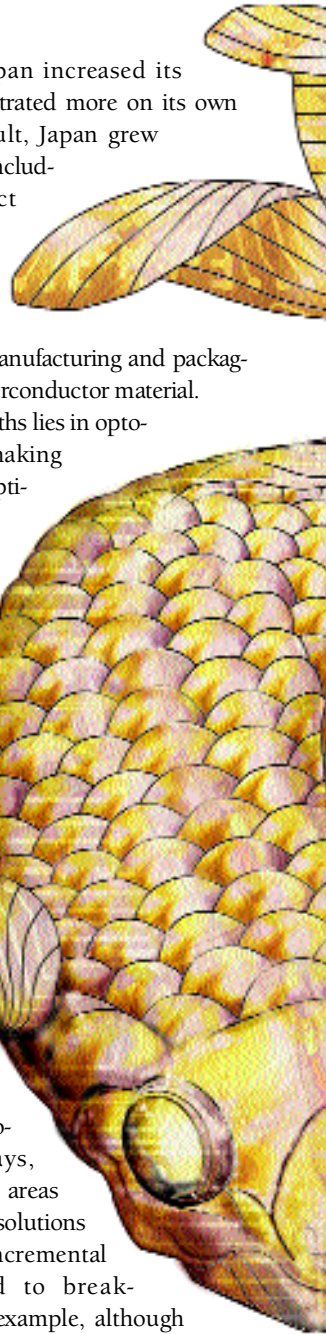
By spending enough money, a country can change its entire approach to R&D, not to mention its success in developing science and technology. Before 1984, Japan largely adapted technology developed in other countries.

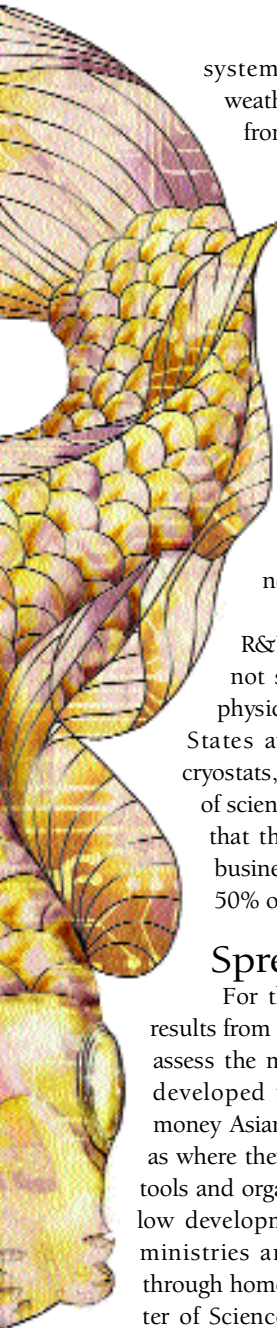
From 1984–94, however, Japan increased its spending on R&D and concentrated more on its own ideas and concepts. As a result, Japan grew strong in several general areas, including applied research, product development, and manufacturing. Moreover, Japan surpassed the United States in many fields, including construction, electronic displays, electronic manufacturing and packaging, integrated circuits, and superconductor material.

One of Japan's greatest strengths lies in optoelectronics—particularly in making optoelectronic devices and in optical-fiber technology. Japan's prowess promises to grow, because various organizations in Japan are developing even more advanced optoelectronics: chip-to-chip interconnects using silica waveguides, optical fuzzy logic, and optical storage media.

Richard Dasher, director of Stanford University's U.S.-Japan Technology Management Center, says, "Japanese researchers excel in areas where highly reliable problem solutions are a priority and relatively incremental developments—as opposed to breakthroughs—are the norm. For example, although Japan has a weak reputation in computer software development, it is strong in two areas in which reliability is paramount: numeric control software—such as for factory automation systems—and computer games. A pattern similar to this one can be found in other areas of electronics and other applied technologies."

Other Asian countries have their own specialties. For example, China recently unveiled the first laser-based





system that guides pilots through bad weather. A pilot can see the laser beams from a height of 8,000–10,000 meters.

South Korea leads the world in the production of dynamic random-access memory (DRAM). Malaysia ranks third in the world for the production of semiconductor chips. Taiwan is likely to increase its competitiveness because it has concentrated on developing microelectronics, which is the foundation for other information technologies. Indonesia uses a microwave-based telecommunication system to “connect” its 13,000 islands.

The increased flow of money for R&D by these major Asian countries is not stopping at the Pacific Rim. Many physics-related companies in the United States and Europe—suppliers of lasers, cryostats, vacuum systems, and other kinds of scientific instrumentation—are reporting that they are now doing 50-75% of their business outside North America with 30-50% of their sales in Asia.

Spreading the news

For those who need to understand the results from basic research in Asian countries, to assess the market potential of new technology developed in Asia, and to track how much money Asian countries spend on R&D, as well as where they spend it, there are numerous new tools and organizations that make it easier to follow developments. A wide variety of Japanese ministries and agencies publish information through homepages. The Japan Information Center of Science and Technology concentrates on worldwide dissemination of information specifically about Japanese science and technology.

Mindy Kotler explains why Japan is willing to advertise to the world this kind of information: “Easing access deflects diplomatic pressures, tests potential information markets, and helps Japan—long accused of being a mere imitator—to prove that it is a significant world scientific power.” Other Asian countries are also

moving toward improved access to their science and technology information. For instance, “Shanghai On Line”—now under development—will be China’s first large-scale on-line information service.

The following reports describe programs and projects that offer more in-depth information and services for those individuals and companies who want to have more than a passive involvement in Asian R&D. Traditionally, small and medium-sized companies that wanted to do business in Asia were on their own—armed with very little information or support, they would seek out willing partners at trade shows and hope for the best. In the past few years, however, government, quasi-government, and not-for-profit organizations have emerged to help raise the odds for success.

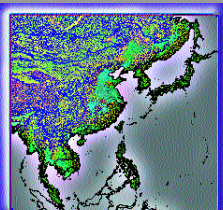
Japan Information Access Project

by Mindy L. Kotler,
Director, JIAP

Established in 1991, the Japan Information Access Project—a non-profit research center located in

Washington, D.C.—operates as a neutral and objective clearinghouse, which does no lobbying or policy-making. Instead, the Project assists scientists, engineers, and policy-makers in accessing and evaluating Japanese scientific and technological information and policies. The results of this analysis appear in the Project’s newsletters, resources guides, and conference proceedings. In addition, technical and policy issues are examined through a very active program of seminars and conferences.

The “Japan Access Alert Bulletin,” for example, provides a bimonthly guide to information resources pertaining to Japanese science, technology, economics, and politics. This newsletter gives scientists, engineers, and policy-makers a “first alert” to emerging industry trends. For instance, the January–February issue revealed a new semiconductor research association established by Japan’s Ministry of International Trade and Industry and a new joint R&D company formed by 10 Japanese chipmakers. This bulletin also helps scientists and engineers gather more information—showing them how to retrieve important reports and where they will be able to find additional expertise.



Asian Technology Information Program



by David K. Kahaner,
Director, ATIP

The Asian Technology Information Program (ATIP)—a U.S. nonprofit organization with offices in Japan, Korea, and China—operates programs around the world, relaying information about Asian science and technology. ATIP operates through a network of experts who live in Asia, and it covers a wide range of topics, including advanced materials, advanced transportation technology, electronics, information technology, robotics, and manufacturing—all with special emphasis on applications.

ATIP provides a regular series of science and technology reports, which can be obtained through subscription, or nonsubscribers can obtain complimentary overviews. In 1995 ATIP released 100 reports; 1996 reports include topics such as “Asian Semiconductor Market/Industry Trends,” “Parallel Computing Efforts in India,” “Singapore’s Smart Taxis,” and “Some Micromachine Activities in Japan.”

In addition, ATIP develops and implements technology tours throughout Asia. These tours typically consist of pre-site briefings; site visits to R&D, manufacturing, and policy/planning locations; a post-site briefing, and a report if desired.

Asia-Pacific Technology Program

by Phyllis G. Yoshida,
Director, OITP

In 1987, the Commerce Department’s Office of International Technology Policy established the Asia-Pacific Technology Program (APTP). In the beginning, the program tracked and disseminated information on developments in Japan alone. Today, it monitors trends across Asia.

APTP provides three primary services. First, it offers representation—negotiating international science and technology agreements and advising senior government and industry officials on the potential impact of Asian science and technology policies and programs. Second, the program dispenses information through electronic and printed publications, business counseling, conferences, a fellowship program, and other special activities. Third, APTP supports presidential and other high-level initiatives that increase balanced and equitable international technology cooperation.

APTP publishes the Directory of Japanese Technical Resources in the United States—a leading source for assessments of important new technological developments, R&D practices, and policies in Asia.

APTP serves as the U.S. coordinator for the Techno-Growth House—a low-cost housing facility in Japan’s Tsukuba Science City for academic, government, and private-sector investigators and officials. APTP also operates the Machine Translation Center—a computerized system that translates documents from Japanese to English. The Center was established in cooperation with the Japan Information Center of Science and Technology.

Tsukuba Science City

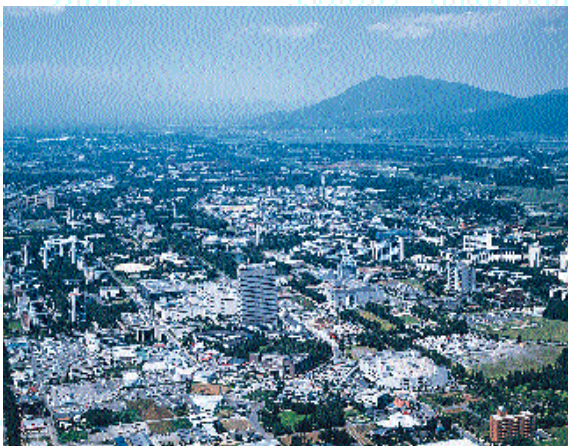
by Robert Lewis, Associate Director,
Tsukuba Research Consortium

Perhaps Japan’s largest effort in science and technology was born from an idea in the 1960s. Development has required about \$14 billion over the last 30 years. Tsukuba now has a total population of roughly 170,000 people, of which 12,000 are researchers. Of these, about 5,000 are researchers at national laboratories, about 2,000 are at universities, and about 5,000 are researchers in the private sector. Nearly half of Japan’s total national laboratory research force is located in Tsukuba. In addition, 48 out of the total 88 national research-oriented facilities are located in Tsukuba. Virtually all fields of research are represented. The total number of private companies doing research is about 160, with many of these coming from abroad.

JRDC and ERATO

The Research Development Corporation of Japan (JRDC) sponsors the Exploratory Research for Advanced Technology program (ERATO), one of Japan’s frontier efforts in science and technology. JRDC is one of seven public corporations within the Science and Technology Agency (STA), which—with a research budget double that of the Ministry of International Trade and Industry—is a major force in Japan.

The ERATO program is open to foreign participation and represents an ideal opportunity for foreign individuals and companies to access Japan’s rich science and technology environment. Research projects in the ERATO program cover a broad spectrum of basic research themes. Since its start in 1981, the ERATO program has sponsored 41 projects, 11 of which have had laboratories in the Tsukuba Research Consortium (see next page); each project supported at a level of about \$15 million for its five-year lifetime. As of June 1995, there were 151 foreign researchers in various ERATO projects.



Aerial view of Tsukuba Science City with Mt. Tsukuba in the background.

Japanese External Trade Organization

by Tadao Nozu
Senior Trade Advisor, JETRO

Tsukuba Research Consortium

An unusual private sector consortium was started in 1980 in an effort to create a free and active environment where young researchers and managers could flourish and where interdisciplinary research would be encouraged. This effort was made because the founders of the consortium thought that the typical company environment in Japan was stifling creativity and growth. The Tsukuba Research Consortium (TRC) is now made up of seven mid-sized high-tech companies—referred to as the core companies—each with a specialty that complements the others. The group includes:

- Hamamatsu Photonics K.K. Photon counting, imaging devices, etc.; 1,783 employees, \$350 million annual sales.
- Harima Chemicals, Inc. Chemicals, food additives, etc.; 492 employees, \$246 million annual sales.
- Japan Metals and Chemicals Co., Ltd. Metals, chemicals, geothermal energy, etc.; 1,121 employees, \$990 million annual sales.
- Stanley Electric Co., Ltd. Automotive lighting, displays, etc.; 4,009 employees, \$1.65 billion annual sales.
- Teisan K.K. Industrial gases, gas delivery systems, etc.; 1,049 employees, \$760 million annual sales.
- ULVAC Corporation. Vacuum pumps, gauges, vacuum systems, etc.; 1,105 employees, \$268 million annual sales.
- Yaskawa Electric Mfg. Co., Ltd. Motors, control systems, robotics, etc.; 4,245 employees, \$1.86 billion annual sales.

In addition, there is a satellite group of approximately ten research-oriented organizations located in TRC's rental facilities.

Large-scale programs have been born from some of the activities that have gone on at TRC. For example, in 1991 an interdisciplinary TRC group that studied new developments in thin organic films gave birth to a one-year STA-funded feasibility study, which in turn resulted in the initiation of a multiorganization research program with funding of \$6 million for three years. Joint research between member organizations has also resulted in products, such as a robotic material-handling device designed for vacuum chambers.

For small and medium-sized U.S. companies that are interested in actually initiating exports to Japan or that want to expand their current business, the Japanese External Trade Organization (JETRO) provides free, one-on-one consultations. There are 7 offices in major U.S. cities and senior trade advisors in 22 economic development regions across the country. JETRO is a nonprofit organization that is part of the Japanese Ministry of International Trade and Industry. 

Internet Sites

Asia-Pacific Technology Program

<http://www.ta.doc.gov/aptp/aptp.htm>

Asian Technology Information Program

<http://www.atip.or.jp>

Japan Information Access Project

<http://www.nmjc.org/jiap/>

Tsukuba Research Consortium

<http://www.trc-net.co.jp/Welcome-E.html>

Japan Related Web Links: Science and Technology

<http://www.panix.com/~tn/j-sci.html>

Stanford University's U.S.-Japan Technology Management Center

<http://fuji.stanford.edu/>

University of Arizona's Japan CS Project

<http://www.cs.arizona.edu/japan/japan.html>

Japan Information Center of Science and Technology

<http://www.jicst.go.jp/>

The New Mexico U.S.-Japan Center

<http://www.nmjc.org/>

Japanese External Trade Organization

<http://www.jetro.org>