International Plans, Policies, and Investments in Science and Technology

April 1997

Overview

Asia

Japan
People's Republic of China
Republic of Korea
Indonesia, Malaysia, Thailand and Taiwan
India

Europe

European Union
France, Germany, and the United Kingdom
Czech Republic, Hungary, and Poland

North America

Canada
Mexico

Other

Australia
Brazil, Chile, and Argentina
South Africa

International Plans, Policies, and Investments in Science and Technology

Sustained economic growth and job creation have long been high on the list of priorities for many nations around the world. With the end of the Cold War, nations have been able to place even greater emphasis on these priorities, and the number of countries implementing policies to achieve these objectives also is increasing.

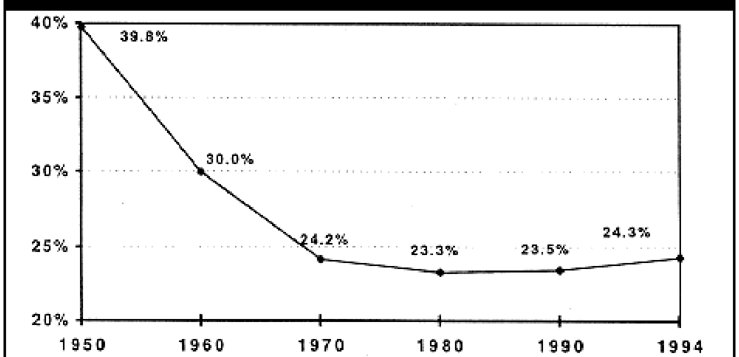
Long-term studies of the United States and other advanced countries show that advances in technology have been responsible for at least half of long-term economic growth—through improvements in capital and labor productivity, and the creation of new products, services and systems. Thus, policies to promote technological advance are playing a significant role in the economic growth strategies of most developed and developing nations. The relative success of nations in achieving their S&T objectives for economic growth will have a direct impact on the competitiveness of the United States and, consequently, on our national economic growth.

Changes in Relative U.S. Position

The United States' relative strength compared with the rest of the world has changed significantly. In 1950, the United States contributed nearly forty percent of the developed world's GDP. In 1994, the U.S. contribution was 24.3 percent of world GDP.

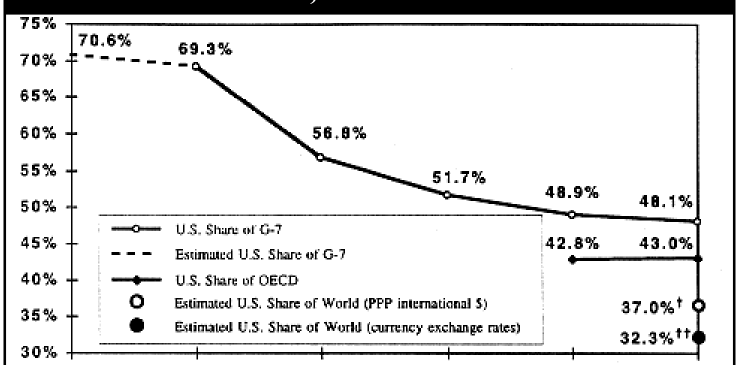
The shift between the United States and the rest of the world has been more dramatic with respect to research and development. In 1950, the United States carried out more than twice as much R&D as the rest of the world. By 1994, the rest of the world was performing approximately twice as much R&D as the United States.

U.S. Share of World GDP, 1950-1994



Source: Penn World Table 5.6, National Bureau for Economic Research, March 1997. U.S. share was 24.1 percent in 1992; 1994 figure is a regression estimate based on 1980-1992 performance.

U.S. Share of G-7, OECD and World R&D



NOTE: 1994 U.S. share of G-7 percentage is estimated. U.S. share of world R&D is an estimate based on most countries that report total R&D. † in purchasing power parity dollars †† in current values currency exchange rates
SOURCES: OECD *Main S&T Indicators* , 1996. OECD *Science, Economic Growth & Government Policy* , 1963. NSF *Science and Engineering Indicators.* 1991 and 1995. NSF *National Patterns of Research and Development Resources-* 1996. Penn World Table 5.6, National Bureau for Economic Research, March 1997. *Global Competitiveness Report-1996,* World Economic Gorum, Geneva, Switzerland, 1996.

Because of U.S. dominance in business and R&D in the first 25 years following World War II, U.S.-based businesses benefited preferentially from advances in science and technology irrespective of their source (e.g., basic research, defense spin-offs, and government civilian R&D). Many of the most important technical breakthroughs occurred in the United States, and U.S. companies had both the time and resources to follow many scientific and technological advances from fundamental discoveries to commercialization. As a result, most U.S. companies looked primarily to domestic and internal sources for new technology.

In recent years, the growth of technical capability outside the United States has resulted in three profound implications. First, sources of technology outside the United States are becoming increasingly important to the growth and survival of U.S. companies. Second, other nations have developed sophisticated technical infrastructures and are well able to directly use the results of basic research, whether developed domestically or elsewhere, including the United States. And third, some foreign nations have developed the ability to rapidly commercialize new and emerging technology, and prosper in an environment of shorter product, process and service life cycles.

International Competitive Landscape

Change in the international competitive landscape has accompanied the shift in the balance of technical and business activity between the United States and the rest of the world. U.S. competitive dominance in the years immediately following World War II was gradually replaced in the 1970s and '80s by a situation in which world competitive leadership was shared by a triad consisting of the United States, Europe, and Japan. By the mid-1990s, this portrayal has given way to an increasingly global economy which also includes a range of rapidly growing nations that are powerful new competitors and, at the same time, provide the prospect of large emerging markets.

More than ever, substantial R&D investments are flowing around the world. In 1993, U.S. companies committed an equivalent of 10 percent of their R&D spending overseas, up from 6 percent in 1985. Foreign companies accounted for 15 percent of all industrial R&D funding in the United States, compared to 9 percent in 1985.

Strategies for sustained economic growth for both developed and developing countries generally focus on two complementary goals: 1) build competitive domestic industries; and 2) attract the engines of economic growth from around the world. All countries are attempting to promote technical advance by investing in assets that remain relatively fixed within their countries. For example, they are investing in people through education and training, and in infrastructure, including transportation and 21st century information infrastructure.

In developing countries, a primary mode of promoting technical advance is often through technology acquisition. In developed economies, the focus is on innovation, and the creation of new technology and higher value-added activities by increasing basic and applied research. For example, Korea in the past has placed its primary emphasis on technology acquisition. As per capita income rises above $10,000, Korea is putting in place major fundamental research and development programs in government and industry in an attempt to attain world leadership in key areas.

Increasing Foreign Investment in S&T

Nations as diverse as Japan and South Africa are implementing ambitious science and technology strategies to ensure that they are ready to play effectively in a knowledge-based world. Not only are our trading partners drawing from foreign, especially U.S., science and technology innovations, they are increasing investment in their own research and development, most of which is focused on the civilian sector. They also are restructuring their economies in ways thought conducive to innovation.

- European nations are accelerating investment in commercial technologies through national programs and European Union (EU) joint R&D initiatives. France is committed to making its publicly-financed research more profitable.
- Japan is well on the way to doubling its government S&T budget by the year 2000 with a proposed increase in its FY 97 budget of 9.9 percent from FY 96.
- The business sector in Canada is becoming more involved with R&D funding and performance than the federal government.
- Australia is investing in its world-class R&D infrastructure to take full advantage of commercial opportunities with the newly emerging economies of Asia.
- The Republic of Korea has considerably boosted its R&D efforts in key technology areas with a plan to increase expenditures by 19.7 percent in 1997.
- The newly emerging Asian economies and nations such as Chile continue to significantly increase the percent of their GDP devoted to science and technology, and target high-value added areas.
- China is planning to triple its investment in R&D by 2000, targeting computers, software, telecommunications, pharmaceuticals and infrastructure.
- South Africa's National Unity government has initiated a $10.5 billion, 5 year plan to restructure the country's S&T institutions.
- India's government has increased its focus on applied research to encourage competitiveness, technology transfer and innovation.
- Central European countries recognize good S&T strategies are vital to their economies as they undergo political and economic restabilization.

Country	GDP 1994 (in million US$, using currency exchange rates)	GDP Growth Rate (1990-1994)	R&D Expenditures as % of GDP
U.S.A.	6,648,013	2.5	2.54
Japan	4,590,971	1.2	2.90
Germany	2,045,991	1.1	2.33
France	1,330,381	0.8	2.38
U.K.	1,071,306	5.7	2.54
Canada	639,900	5.7	1.5
Brazil	554,587	2.2	0.70
PRC (China)	522,172	12.9	0.6
Mexico	377,115	2.5	0.31
Rep. of Korea	376,900†	6.6	2.6††
Australia	331,990	3.4	1.56
India	267,070†††	3.8	0.73†††
Argentina	281,922	7.6	N/A
Taiwan	234,000	6.5	1.82
Indonesia	174,640	7.6	0.26
Thailand	143,209	8.2	0.15
South Africa	121,888	-0.1	0.96
Poland	92,580	1.6	0.8
Malaysia	70,626	8.4	0.37
Chile	51,957	7.5	0.78
Hungary	41,374	-2.0	0.8
Czech Republic	36,024	-4.7	0.42

SOURCE: WORLD BANK, From Plan to Market: World Development Report 1996; and Science and Engineering Indicators, 1996. † GNP. †† Based on GNP. ††† 1992-93.

Implications for U.S. Technology Policy

Policies that served the U.S. national interest well during the period of U.S. dominance are no longer sufficient as economic/technological power becomes more globally distributed.

Improved Access To, And Awareness Of, Foreign S&T. As the sources of new science and technology proliferate beyond the United States, access to, and interaction with these sources, is increasingly critical to the growth and survival of U.S. corporations. As U.S. corporations strive to be better "hunters and gatherers" of technology from around the world, the U.S. government must focus its programs and policies to provide better access to, and broad awareness of, foreign science and technology.

Beyond Basic Research. As foreign competitors increasingly acquire the capability to capitalize on the results of basic research — regardless of where in the world the research is performed—U.S. basic research programs provide less unique national competitive advantage than they may have in the past. National technology policy must go beyond a strong federal role in basic research.

Need For Partnerships. As foreign competitors have been able to speed up the commercialization process and survive and grow in an era of shorter product, process and service life cycles, industry-university-government partnerships have become critically important as a way to speed up the research through the commercialization process in the United States. Partnerships help ensure that more of the output of U.S. universities ends up being commercialized in the United States.

JAPAN

Japanese Cabinet Approves Science and Technology Basic Plan

To maintain its status as one of the most competitive nations in the world, Japan will create new markets by providing products and services by incorporating leading-edge technology and by finding new applications for existing technology. Thus, Japan continues to strive to become a nation based on "creative" science and technology. The Japanese Cabinet's approval of the Science and Technology (S&T) Basic Plan in July 1996 is illustrative of Japan's intensified focus on this goal.

The S&T Basic Plan attempts to restructure Japan's science and technology system to make it more innovative and cost efficient while dramatically improving the research environment. In support of these objectives, the S&T Basic Plan contains a recommendation that the Japanese government spend ¥17 trillion (US$ 155 billion) during the 1996-2000 timeframe, doubling its S&T expenditures. In keeping with this goal, the Japanese government spending is proposed to increase 6.8 percent in JFY 97 over spending JFY 96 in the initial budget. The proposed budget for government S&T expenditures for all ministries and agencies in JFY 97 is ¥3 trillion (about US$ 26.3 billion) in the initial budget, with ¥157 billion (US$ 1.4 billion) added in the supplementary budget.

JAPAN'S S&T VISION FOR THE YEAR 2000

Japan's comprehensive science and technology policy involves joint efforts by the national government, regional and local governments, public corporations and private industry. The basic framework of this policy seeks to:

- Increase R&D investment
- Improve the R&D infrastructure
- Stimulate research and creativity
- Intensify international S&T activities
- Promote science and technology locally
- Ensure an adequate base of scientific and technological personnel

A major part of this vision is to increase support for basic research in order to develop an indigenous capacity for technological innovation, and thus, the creation of new industries and markets. Japan has traditionally been weak in basic research, having relied heavily on technology imported from abroad. Thus, much of the funds in the S&T budget allocations are being directed towards the support of basic research and improving the S&T infrastructure. Increased funding for basic research and S&T programs is a strong indication of Japan's current direction in S&T policy.

S&T BUDGET ALLOCATION

Japan's government S&T funding continues to increase at a higher rate than spending in the overall budget. Japanese total spending on S&T was boosted 6.9 percent in JFY 95, which was the highest percentage increase since 1979 up to that point. The JFY 96 S&T budget was ¥2,810.7 billion, which represented a 12.5 percent increase from the previous year. The proposed level of Japan's S&T budget for JFY 97 continues this trend with an initial budget of ¥3,002.5 billion and a supplementary budget of ¥157 billion. This positive upswing in spending demonstrates Japan's commitment to doubling its long-term S&T expenditures by the year 2000.

The three agencies that have the most significant allocations of the overall S&T budget all will witness healthy, budget increases in JFY 97:

	JFY 96	JFY 97
Science and Technology Agency	692.8	734.5
Ministry of Education & Culture	1,241.2	1,288.8
MITI	421.6	472.3

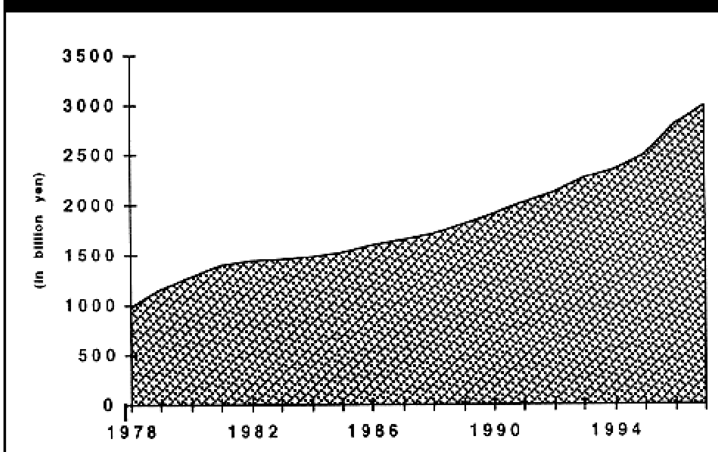
(Unit: ¥ billion)

The Science and Technology Agency's (STA) budget for S&T will experience the highest increase from JFY 96, up by 6.0 percent. The Ministry of Education's budget will be raised by 3.8 percent and the Ministry of International Trade and Industry's (MITI) budget will be increased by 1.2 percent.

Japanese S&T Spending

This bird's eye view of Japan's S&T budget allocations from JFY 78 to date illustrate this steady increase in expenditures.

Japanese Government S&T-related Budget



Source: National Science Foundation

NOTE: All U.S. dollar figures are in current dollars using currency exchange rates unless otherwise noted.

Measures Toward Improving the S&T Infrastructure

In addition to increased S&T funding, the S&T Basic Plan stresses new measures to improve and enhance efficiency within the Japanese S&T infrastructure, and to make it more "creative." The plan proposes to:

- End lifetime employment for some researchers
- Establish some open competitions for grants
- Expand the number of foreign researchers in Japan
- Upgrade university and national laboratory facilities
- Increase researcher mobility
- Develop information and intellectual infrastructures for R&D

Some examples of ways in which the Basic Plan is being realized include:

- MITI, in collaboration with the City of Nagoya, is slated to establish a new ceramics R&D center at a funding level of ¥8 billion over two years. Representing a break from Japan's past practice of limiting researcher mobility between the corridors of government, industry and academia, the program will bring researchers from all of these sectors to work together, free from restrictions.
- The Ministry of Education, Science, Sports and Culture (Monbusho) is funding, through the auspices of "The Research for the Future Program," twenty-one venture business labs at various universities throughout Japan to strengthen university-industry ties and promote the development of new technologies.
- The Japan Technomart Foundation of MITI is establishing a database of approximately 200,000 unused patent rights which it will make available over the Internet. Targeted users of the database are small and medium sized companies.

These moves, which are consistent with the measures outlined in the S&T Basic Plan, seek to dramatically improve the research environment and enhance Japan's international leadership in science and technological innovation. Japan policy makers believe that, if successfully implemented, these changes will create a more balanced approach to science and technology to make Japan a leader in basic as well as applied science. Japan intends to catapult to ever higher levels of success, becoming even more of a powerhouse in creating new technologies, goods and services.

PEOPLE'S REPUBLIC OF CHINA

China Seeks Structural Changes to Improve Global Competitiveness

The People's Republic of China is the world's seventh largest economy and growing rapidly. Its 1996 GDP of $816 billion reflects a 9.7 percent increase over 1995, and China hopes to maintain its extraordinary annual GDP growth rate of 8-9 percent through the year 2010.

China recognizes that it must enhance its technological capabilities to reach its economic goals. It is investing heavily in science and technology to ensure its competitiveness in global markets well into the next century. It is also placing a high priority on acquiring foreign technology and foreign investment to accelerate this process.

STRATEGIC ECONOMIC GOALS

China's three main priorities for its Ninth Five Year Plan (1996-2000) are to improve the application of technology to the agricultural sector; to develop a national information infrastructure; and to increasingly automate manufacturing processes. To achieve these goals, China is expected to continue to encourage domestic assimilation of foreign manufacturing processes, encourage indigenous development of emerging technologies, license key technologies, and acquire know-how and technologies which are bundled with equipment purchases.

China's technology policies are aimed at diffusing foreign technology and encouraging indigenous development of emerging technologies. These policies will discourage the acquisition of equipment and turnkey plants that have little effect on the nation's ability to develop its technological capabilities.

Despite China's strong national commitment to technology-driven growth, the nation faces many challenges. Chinese officials note the primary challenges are:

- Most enterprises still lack any market-driven initiative to utilize science and technology.
- Scientific research results only minimally contribute to economic development.
- Valuable technical resources are wasted on the irrational dispersion of research capabilities and duplication of research efforts.
- Importation of advanced technology is not well integrated with domestic research so that assimilation of foreign technology strengthens domestic technical capabilities and leads to innovation.

China's leadership believes that meeting these challenges will require structural change and better coordination of scientific research and technology deployment programs to manufacturing.

China has targeted emerging technologies where it has strong basic science capabilities, benefits cut across industrial sectors, and/or the application supports China's economic development goals. It believes the following six industrial technologies will help fuel innovation in the next century:

- advanced materials
- microelectronics
- biotechnology
- information technologies
- industrial automation
- energy

MAJOR RESEARCH PROGRAMS

Research programs have been developed which coordinate research topics to economic objectives and ensure research institutes compete for an opportunity to work on a particular technical problem or objective. China's major science and technology programs are:

- *Spark Program*: Diffusion of advanced agricultural techniques.
- *Key Technologies Program*: Support for research in areas of key importance to national economic development.
- *Advanced Technology Development Program (863 Program)*: Support for fundamental research in emerging advanced technologies which include advanced materials, microelectronics, biotechnology, information technology, industrial automation, and energy.
- *Torch Program*: Support for applied research and commercialization of 863 Program results. Fifty-two technology industrial parks have been established.
- *Productivity Promotion Centers*: Technical support for commercialization of technology by small and medium sized enterprises. Services include business management training, technical assessment, commercial feasibility assessment, prototype development, technical training and other forms of assistance.

NOTE: All U.S. dollar figures are in current dollars using currency exchange rates unless otherwise noted.

Scientific and Engineering Indicators

Although governmental expenditures and national expenditures have increased since 1988, real growth has fluctuated. In 1994 and 1995, 0.5% of the gross domestic product was expended on science and technology. In 1995, the actual expenditure was 83 billion yuan, approximately $10 billion. China's goal is for S&T expenditures to reach 1.5% of GDP by the year 2000. Assuming no fluctuations in U.S. or Chinese currency, national expenditure would be $30 billion at the turn of the century.

Science and engineering indicators show more productivity in terms of research publications, patent registration, distribution of technical personnel in key industrial sectors, technology assimilation, and new product development.

Technology Assimilation. Enterprises began to apply technology to manufacturing. In 1992 10,600 of 17,000 large and medium size state owned enterprises were engaged in technology development activities (62.4%). These enterprises undertook a variety of activities to apply technology to manufacturing.

Technical Personnel are Distributed in Key Industries. Scientists and engineers are concentrated in three industries - machinery (32%), electronics (14.4%) , and chemicals (12.3%).

New Product Development. The total national expenditure for new product development is concentrated in machinery, electronics, and chemicals. In 1992 total expenditure for new product development reached 8.73 billion yuan (US$ 1 billion) with electronics accounting for 57.9 percent.

Global Interdependence

China is moving to globalize its research and development.

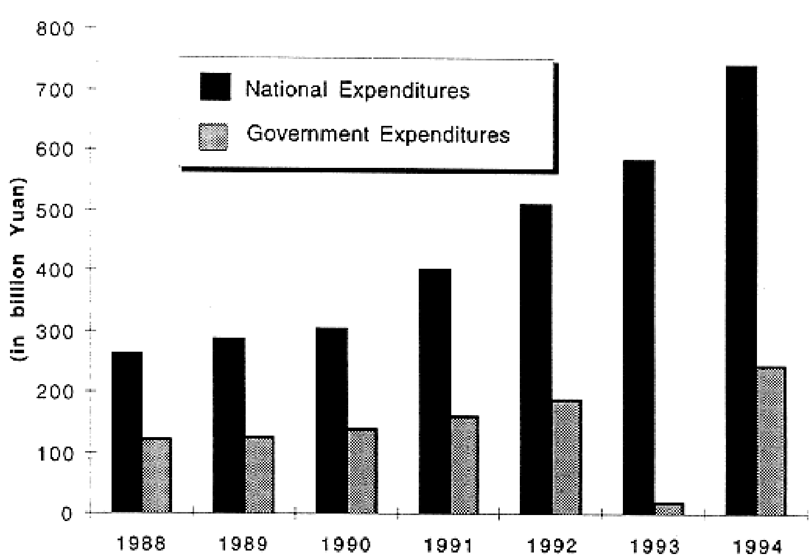
- Statistics on foreign patent registration in China show foreign activity is increasing quickly.
- Foreign corporations have undertaken a variety of technical alliances and research projects in China.
- Affiliates of Chinese companies have begun to conduct research in the U.S.
- Chinese patent activity in the U.S. is just beginning. Between 1963 and 1993, Chinese inventors registered 435 patents.

U.S.-CHINA TRADE IN ADVANCE TECHNOLOGY PRODUCTS
(in millions of U.S. dollars)

	1990	1994
Total Advanced Technology Exports	$ 1,241.5	$ 3,087.4
Biotechnology	0.5	1.4
Life Sciences	87.7	140.9
Optoelectronics	3.2	5.1
Computers and Telecommunications	239.3	716.1
Microelectronics	24.0	41.2
Computer Integrated Manufacturing	60.8	177.4
Material Design	8.4	33.4
Aerospace	801.1	1949.2
Nuclear	3.5	2.8
Weapons	12.9	20.0

SOURCE: National Science Board, Science and Engineering Indicators 1996 (Washington: Government Printing Office 1996) at 254-262.

Chinese National and Government S&T Expenditures



Government Expenditures

Financial support from the central government for research undertaken by the Chinese Academy of Science, research units aligned with central government industrial ministries, and grants awarded to elite universities on a competitive basis for government directed research.

National Expenditures

Financial support obtained from non-central government sources for research undertaken by colleges, universities, and non-state owned enterprises.

SOURCE: State Science and Technology Commission, *Science and Technology Newsletter*, December 30, 1995. NOTE: Currency exchange rate is 8.3 Yuan to US$1.00

Republic of Korea

Korea Continues to Expand Its Aggressive S&T Globalization Strategy

The Republic of Korea (Korea) is betting that a continued emphasis on technological innovation and a substantial investment in R&D will enable it to develop a high-technology industrial base on par with the major industrialized nations. It is preparing for an era in which it sees globalization dominating every field of human activity, including science and technology.

Korea is one of the world's most formidable competitors, with much of its economic strength built on technology-intensive industries. In 1994, total Korea's total R&D investment, public and private, was $9.8 billion. However, there is growing concern from the Korean government and industry that Korea's rapid economic growth has lost some of its momentum. The concern is rooted in Korea's rising labor costs, raising the specter that Korean products will be less competitive than other newly-emerging economies. Korea plans to retain its international competitive position by using S&T to offset rising labor costs. In 1995, Korea increased its government investment in science and technology by 69 percent to $3.1 billion, from $1.8 billion in 1994.

Korea's Comprehensive S&T Plan

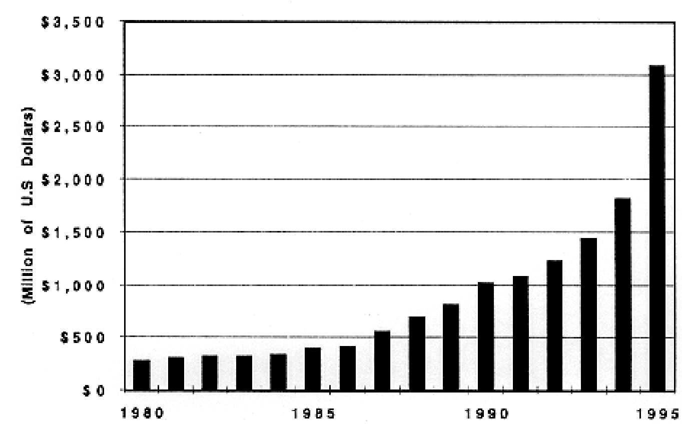
In its quest to increase international competitiveness in science and technology, Korea is undertaking a three-step approach to improve and enhance its existing S&T infrastructure. First, the Korean government has strengthened its national R&D projects that seek to develop core and fundamental technologies. Second, greater emphasis is placed on basic science and education in order to turn Korea into a high caliber technological powerhouse. And third, Korea is implementing incentive programs to enhance private sector innovation.

Korea's strategy to strengthen its industrial R&D programs is centered on the Highly Advanced National (HAN) Projects. The HAN projects identify and develop strategic industrial technology requiring nationwide R&D investment. The budget for these projects in 1996 was $ 313.4 million. The Korean government's 1997 investment increased to $378.3 million with a focus on such areas as biomedicine, agricultural chemicals, next generation semiconductors, and high-definition television.

Nine industrial sectors are targeted for development, with selection based on existing technology capabilities, international comparative advantage, the country's energy and resource base, growth potential, and social development criteria. They are:

— informatics
— fine chemicals
— biotechnology
— oceanography
— environmental technology
— information technology
— precision machinery
— new materials
— precision machinery
— aeronautics

Korean Government's S&T Investments



Source: Korea Industrial Technology Association, 1996. (in current U.S. dollars)

Another of Korea's primary objectives within its long-term S&T strategy is to establish a strong, yet sophisticated basic research capability. The formation of the Korea Institute of Advanced Study (KIAS), Korea's newest R&D institute, is one of the major ways in which Korea hopes to attain this goal and increase competitiveness in its industrial and technological base. This institute will specialize in technologies residing in the field of physics, mathematics, chemistry, and biology.

The KIAS institute is modeled after the Institute for Advanced Studies of Princeton, the Neils Bohr Theoretical Physics Research Institute in Denmark, and Germany's Max Planck Gesellschaft. It is envisioned to have 15 distinguished professors (level of Nobel laureates), 50 professors, and 100 research fellows. The staff are to be recruited from around the world and will have unlimited freedom to follow their respected topics of research and interests.

NOTE: All U.S. dollar figures are in current dollars using currency exchange rates unless otherwise noted.

The Korean government provides various incentives to the private sector to increase investment in R&D and speed industrial innovation. For example, the Ministry of Trade, Industry & Energy's 1997 budget for technology infrastructure increased four fold from 1996 to $182 million. The increase is to support the acceleration of the adoption of industrial technologies, develop human resources, and promote standardization of technologies. Special attention also will be given to the visual entertainment industry, techno-parks, and aircraft manufacturing. In addition, the government plans to spend $522 million over the course of 1997-2001 period to build two to three techno-parks, which will "incubate and hone" industrial technologies being developed in universities.

Highlights and Trends in Korea

Korea is one of the United States' most significant trading partners. It is the world's largest producer of dynamic random access memory (DRAMS) chips, and among the top manufacturer of ships, consumer electronics, and automobiles. In recent years, Korea has demonstrated extraordinary economic growth with annual GDP growth ranging between 5 and 8 percent. Most of Korea's growth has been achieved through investment in large-scale facilities, infrastructure development, and aggressive acquisition of highly advanced technology available in the global market.

The Korean leaders believe that continuation of Korea's high economic growth will depend increasingly on technological innovations produced within the boundaries of Korea. As a result the government is placing greater emphasis on ways to stimulate indigenous technical advancements and to create a business climate more conducive to innovation. In 1996, the government spent $1.1 billion on non-defense R&D.

International Science & Technology

Korea has been an increasingly active player in international science and technology. Despite its commercial success, Korea must still seek foreign technology and international partnerships if it is to meet its goal of joining the "ranks" of the advanced countries by 2001. While its production and manufacturing technology is on par with many advanced nations, it still lags behind in many other areas. Therefore, in addition to cooperation with foreign companies, it is stressing technology transfer through academic cooperation, joint international research projects and other information exchange forums.

In November 1996, Korea hosted the second Asia Pacific Economic Cooperation (APEC) Ministers Conference on Science and Technology. Korea plans to take a leading role in science and technology within APEC with particular emphasis on basic science and the creation of a strong human resources infrastructure. With its full admission to the OECD in November 1996, Korea also is taking a more active role in the OECD's Committee on Scientific and Technological Policy. Participating in these two multilateral organizations has allowed Korea to further cement its international role in science and technology.

Korea continues to expand other international S&T efforts. In February 1997, the Korean Ministry of Science and Technology opened its Korea-U.S. Center for Science Cooperation in the Washington, D.C. metropolitan area. This Center houses the Washington offices of the Korea Science and Engineering Foundation and the Korea Institute of Machinery and Metals. It is expected that other agencies will move into the Center during the next year. In addition, the Korean chaebols continue to establish R&D laboratories in the United States. The number of labs has more than doubled, from about a dozen in 1992 to 27 in 1995.

INDONESIA, MALAYSIA, THAILAND, AND TAIWAN

Emerging Asian Economies Push to Become Players in Science and Technology

Over the past two decades, Asia's technological infrastructure has grown dramatically in sophistication. The emerging Asian economies all see a link between science, technology, and economic growth. While still primarily importers of technology, they are building indigenous capabilities through foreign investment and extensive workforce and industrial training programs. All are characterized by strong GDP growth rates, increasing levels of R&D investment, and movement towards higher-value added, more technology-intensive industries.

INDONESIA

Indonesia has a long-term record of steady growth. It now has a GDP of $166.1 billion that has been growing at an average rate of 7 percent annually. The Indonesian government has decided that science and technology will play an important role in maintaining the country's economic expansion. R&D spending rose from 0.12 percent of GDP in 1990 to 0.26 percent in 1994.

Indonesian science and technology policy emphasizes industrial development. The policy pays special attention to human resource development, small and medium-sized companies, and technology-intensive industries. And while government institutions still dominate many R&D activities, they are restructuring to be more relevant to industry.

As part of its effort to move from an agrarian to an industrial society, the Indonesian Government plans to invest over $113 billion in the aerospace, telecommunications and energy sectors. Environmental and health care technologies are also priorities. Indonesia is seeking foreign technology and partnerships to speed developments in these areas.

One of the most progressive trends in Indonesia is the use of information technology. Indonesia's 13,000 islands stretch 3,300 miles east to west, and 1,300 north to south, posing a formidable information technology challenge. Microwave transmission has bridged this distance and become the backbone of the Indonesian telecommunication system, serving as the long distance link within the islands. Indonesia expects to invest over $73 million within the next year in building its information infrastructure.

MALAYSIA

Malaysia is one of the top high-tech performers among the South East Asian economies. Its economy is booming. Its GDP growth rate averaged 8.7 percent from 1989 and 1993. As the economy continues to grow, so does the consumer base and its purchasing power. Per capita GDP reached $3,500 per person in 1994. Gross domestic expenditures on R&D reached approximately $214.9 million in 1994, or 0.37 percent of GDP.

Because of its high economic growth and industrialization, Malaysia has grown from primarily a commodity exporter to an exporter of many electronic products and is now the world's third largest producer of semiconductor chips. Its growing economy, skilled workforce, overall business environment, political stability and the presence of major multinational electronics firms continue to attract high-tech investment and technological cooperation.

The *Second Outline Perspective Plan* and *Vision 2020* recognize the importance of science and technology to the country's industrialization efforts and its global competitiveness. Also, under the *Sixth Malaysia Plan* (1990-1995), the government allocated RM 600 million ($234 million) for R&D activities under the *Intensification of Research for Priority Areas (IRPA) Programme*. The *Seventh Malaysia Plan* (1996-2000) will institute a competitive bidding process for R&D projects and try to ensure that projects are more relevant to industry. Malaysia has already invested over $90 million in environmental technologies; health care technology is another priority area for government spending.

In its efforts to be fully "industrialized" by the year 2020, the Malaysian government plans to spend at least $2 billion annually on improving its telecommunications infrastructure. Malaysia's information technology market has evolved into one that demands sophisticated technology.

TAIWAN

Taiwan is likely to continue improving its competitiveness as one of Asia's new competitors in advanced technologies. GDP grew at an average annual rate of 6.5 percent during the 1989-1993 period, with GDP in 1994 reaching 6,459 million won ($244 billion). Governmental spending on science and technology is approximately 1.82% of its GDP and rising.

Taiwan has a solid record of investment in science and technology infrastructure, and in turning technology into products for export (especially in microelectronics infrastructure). For example, Taiwanese authorities and industry have built Hsinchu Science Park into one of Asia's foremost science and

NOTE: All U.S. dollar figures are in current dollars using currency exchange rates unless otherwise noted.

technology parks. It hosts 173 small entrepreneurial companies that primarily produce integrated circuits, personal computers and computer peripherals. In the first half of 1995, they generated $5 billion in sales.

Its infrastructure for science and technology research combines the skills of scientists in academia and quasi-governmental research labs. Universities perform basic research and often concentrate on a single specialty. Tsinghua University concentrates on nuclear technologies, National Polytechnic University has the lead on electronics, and Central University specializes in atmospheric research. These universities coordinate with the Industrial Technology Research Institute (ITRI) to commercialize technology which ITRI believes is viable in the domestic market.

ITRI is a non-governmental, publicly funded organization that bridges the gap between basic governmental research and private industry. Since 1972, ITRI has performed industrial research, developed new industrial products and production methods, and transferred research results to the marketplace. It also coordinate Taiwan's research entities, analyzes industrial development, conducts and reviews feasibility studies for new industrial technologies, and collects foreign scientific and technology information. ITRI organizes its research centers according to scientific discipline. They are:

- Electronics Research and Service Organization (ERSO)
- Opto-electronics and Systems Laboratories (OES)
- Computer/Communication Research Laboratories (CCL)
- Union Chemical Laboratories (UCL)
- Energy and Resources Laboratories (ERL)
- Mechanical Industry Research Laboratories (MIRL)
- Materials Research Laboratories (MRL)
- Center for Measurement Standards (CMS)
- Center for Pollution Control Technology (CPCT)
- Center for Aviation and Space Technology (CAST)
- Center for Industrial Safety and Health Technology (CISH)

ITRI receives funding from the government to establish an environment for basic research, implement national applied research projects, and assist small and medium sized businesses. It also receives funds from industry to execute joint development and contract projects for technical services, and to disseminate technical information. The Industrial Technology Investment Corporation, a part of ITRI, commercializes the research.

Thailand

Thailand's outward-looking, market-oriented economic policies encourage foreign direct investment as a means of promoting economic development, employment and technology transfer. The success of these policies has allowed Thailand to enjoy annual economic growth rates averaging nearly 10 percent from 1983 to 1993.

In concert with increases in economic growth, the 1993-1995 Thai science and technology budget rose to 5,289 million bath ($210 million) or 0.15 percent of GNP in 1995. The Ministry of Science, Technology and Industry is developing the Eighth Five Year Plan which will start in 1997. This plan stresses scientific and technical workforce development, technology transfer, research and development, and building the science and technology infrastructure. Thailand is still developing its infrastructure and will continue to rely on foreign direct investment, R&D, and technology attracted by the country's low labor costs and open markets.

Thailand's rapid growth has caused infrastructure bottlenecks, environmental degradation, and shortages of skilled personnel. Thailand will spend more than $100 billion in the 1995-2000 period on infrastructure and workforce development. Thailand's Ministry of Science, Technology, and Environment (MOSTE) had established an environmental fund with a projected annual budget of $80 million through 1996. Also, MOSTE has set up the *"Revolving Fund for Technology Research and Development and Technology Development Fund"* to encourage private sector R&D and improve production processes. It also provides technical support and technical services such as testing and quality control for companies. In addition, companies can deduct 150 percent of actual R&D expenses from taxable income.

INDIA

Economic Liberalization Spells Success for Science and Technology on the Sub-Continent

"It is an inherent obligation of a great country like India, with its traditions of scholarship and original thinking and its great cultural heritage, to participate fully in the march of science, which is probably mankind's greatest enterprise today."
—*Government of India Scientific Policy Resolution, 1958*

"In the last five years, there has been a sea-change in the economic, political and technological environment the world over... A new vision of India as a major player in the global setting has been articulated. The wave of change sweeping the country and the world has thrown up a myriad of opportunities and at the same time posed daunting challenges for all sections of Indian society."
—*Council of Scientific & Industrial Research, January 1996*

In its bid to become a globally competitive nation, India adopted a system of economic reforms and market liberalization policies in 1991. These policies have had a distinct effect not only on India's economy, but on India's science and technology policy as well. R&D expenditure has been rising among all sectors of the economy and in 1992-93, total R&D expenditures were 0.73 percent of GDP or almost $2 billion. The government has moved away from funding basic science and has shifted its focus to applied research. Today, only 10-15 percent of the entire federal budget for R&D is allotted for basic science. The government's new priorities are competitiveness, technology transfer, and innovation.

To meet these goals, the Indian government is encouraging links between the national labs, industry, and academia. The policy guidelines provide incentives to industry for developing solid ties to the university research infrastructure and the national labs. The Council of Scientific and Industrial Research (CSIR), controls over 40 national labs and is responsible for the utilization of the results of the research conducted at the labs for the development of Indian industries. Despite difficulties, the new head of CSIR is enthusiastically launching new efforts to move national research into commercialization.

SPECIFIC POLICY INITIATIVES

The Indian government has implemented a variety of programs aimed at providing incentives for innovation, increasing the speed of commercialization of research and transferring technology. These programs include:

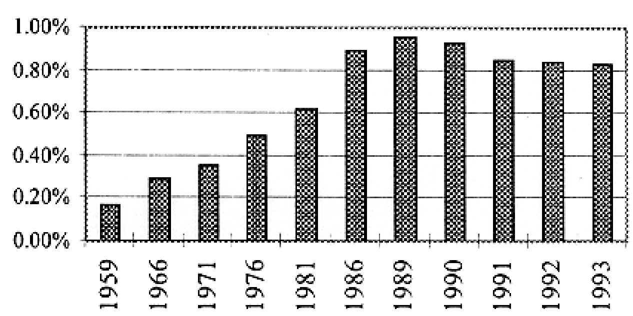
- The Indian government provides income tax benefits for private companies to perform R&D and to form relationships with universities and national labs. These tax benefits include customs rebates for a variety of R&D related resources.
- The Indian government provides funds for upgrading indigenous or imported technology. The government also will fund research whose development process is too onerous or risky for a business to take on itself. The industrial sectors that the government is most concerned with for this type of funding are electronics, microelectronics, pharmaceuticals, and biotechnology.
- The Technology Development Fund**,** is generated from the revenues of a specific import tax. The fund is used specifically for Indian technological development with an emphasis on innovation.

TRUST AREAS: INFORMATION TECHNOLOGY AND BIOTECHNOLOGY

To meet the high demand for information technology, the Indian government has encouraged the growth of software parks for IT development. These parks are crucial not only for the commercial basis of their work, but are also a key factor in the development of India's technological infrastructure. This industry has grown more than 50 percent per year for the last 5 years, pushed forward by the government's liberal export taxation policy. As this policy also applies to foreign companies manufacturing in India, a multitude of multinational companies with technology to transfer to India have already taken advantage of the huge market for their goods and this tax incentive. Hewlett Packard, Bell, and Compaq are all marketing products to and subcontracting in the Indian market.

The second trust area, biotechnology, is moving slower than information technology for a number of reasons. The government provides incentives for growth, but not at the level it does for information technology.

Indian National Expenditure on R&D as a Percentage of GNP



Source: The Department of Science & Technology, India

EUROPEAN UNION, EUREKA, ESA

Fourth Framework Invests Approximately $3.4 Billion Per Year in R&D

European nations continue to invest heavily in joint R&D organizations to leverage national spending and to take advantage of the synergies that cooperation offers among countries in close geographic and cultural proximity. These joint activities are increasing in size and scope.

THE EUROPEAN UNION AND THE FOURTH FRAMEWORK

The *European Union (EU)* is in the midst of an $18 billion five-year effort to increase European competitiveness and create jobs by strengthening the region's science and technology base. The EU's Fourth Framework program is a blueprint for R&D spending during 1994-1998, and targets high technology sectors. The Fourth Framework is spending approximately $3.4 billion per year.

These investments are being made in cost-shared partnerships with major European technology companies that are already global competitors. While Europe designed the Fourth Framework to address barriers that hamper innovation in some areas, a successful program could help Europe compete effectively with the United States in lucrative high-technology markets of the future.

◆The major goals of the Fourth Framework are to: promote economic growth and employment through technology; assist industry in developing new products; exploit research findings; facilitate training and mobility of researchers; and increase global economic cooperation with non-member countries.

◆The Fourth Framework's five-year budget, recently increased to accommodate the admission of Austria, Finland, and Sweden to the EU, is $17.2 billion. Investments focus on:

• Research, Technological Development, and Demonstration Programs	$15 billion
• Stimulation of Training and Mobility of Researchers	$1 billion
• Cooperation with Third Countries and International Organizations	$756 million
• Dissemination and Optimization of Results	$462 million

◆The largest Fourth Framework activity—Research, Technological Development, and Demonstration Programs — targets:

• Information & Communication Technologies	$ 4.8 billion
• Energy	$ 3.2 billion
• Industrial Technologies	$ 2.8 billion
• Life Sciences and Technologies	$ 2.2 billion
• Environment	$ 1.5 billion
• Transport	$257 million
• Targeted Socio-Economic Research	$148 million

◆The European Commission recently recommended $917 million in additional spending for FY 1997-1998 for five special technology task forces:

• Environmental Tech for Water & Nuclear Safety	$249 million
• Aeronautics	$210 million
• Car of the Future	$170 million
• Multimedia Software	$165 million
• Intermodal Transport	$118 million

THE EUROPEAN SPACE AGENCY

The *European Space Agency (ESA)*, a 14-member organization with an annual budget of $3.2 billion, promotes technology development and scientific research in space. ESA has helped Europe develop an independent launch and space technology capability to compete with U.S. firms. Member countries use ESA as a mechanism to develop their national aerospace industries. France has been ESA's largest contributor and beneficiary, though Italy, Germany, and Britain have each derived substantial benefits. Although ESA collaborates with NASA on scientific missions, the two agencies do not share technologies.

Almost half of ESA's $3.2 billion FY 1996 budget was spent on launchers, microgravity research, and telecommunications, areas with direct commercial significance.

EUREKA

EUREKA is a 24-member "bottom-up" mechanism to increase European competitiveness in R&D-related fields and high technology markets. Launched in 1985 as a response to the U.S. Strategic Defense Initiative, EUREKA coordinates and sponsors joint research projects in advanced technology proposed by firms within the member countries. As of November 1996, EUREKA had 669 ongoing projects with 3,175 participants, and had spent $11.4 billion. Both public and private sources fund projects.

EUREKA members include the 15 EU members, plus the Czech Republic, Hungary, Iceland, Norway, Poland, the Russian Federation, Switzerland, Slovenia, and Turkey. Of 3,175 participants in ongoing projects, 2,191 are companies, 851 institutes, and 133 other organizations.

In June 1996, EUREKA launched the Micro-Electronics Development for European Applications (MEDEA) program. At $2.5 billion, MEDEA is the largest of EUREKA's new projects. MEDEA will run from 1997-2000 and will promote advanced semiconductor technologies in multimedia, communications, automotive technologies, transport, and other areas. It includes the participation of Europe's major electronics firms, such as Alcatel, Bull, Siemens, and Philips.

NOTE: All U.S. dollar figures are in current dollars using currency exchange rates unless otherwise noted.

France, Germany, and the United Kingdom

European Nations Speed Development of Commercial Technologies; Revamp R&D Systems

European governments are investing billions of dollars in national programs to increase their technological competitiveness. France, Germany, and the United Kingdom combined invested $26.8 billion in 1994 on public sector non-defense R&D initiatives compared to $30.6 billion ($33.5 billion in FY 1997) for the United States. Germany's non-defense R&D investments, as a percent of GDP, exceed that of the United States, while French investments equaled U.S. spending on a GDP basis.

European countries invest heavily in technology development to strengthen their global competitive position. France, Germany and the United Kingdom each sponsor major programs to link public and industrial R&D. And all three nations provide financing for pre-competitive technologies and other forms of technology assistance for private firms, in some cases modeling their efforts on programs started in the United States.

France

In the course of 1996, the French Government enhanced its efforts to use public funds to stimulate technological innovation. With government funding for R&D down by about 3.4 percent in real terms from the previous year and private industrial R&D growth flat, France was trying to meet new goals by reorienting existing funds and recasting its policies. The new French program included:

- Significant redirection of public research budgets
- Enhanced funding for technology development and diffusion projects for the private sector

In its 1997 state research budget, the French Government launched more changes in its public sector research policies. In this document, France committed to make publicly-financed research more "profitable" by reorienting it toward economically rewarding research programs. The government's goal is to stimulate research and development in the following six priority areas that it judges to have the greatest economic and job creation potential:

- Electronics and information technologies
- Road and air transport
- Chemistry
- Agro-food industry
- Industrial product and process innovation
- Medical research (infectious diseases, genetics, microbiology, and biotherapies)

To support these goals, the government is launching multi-year programs in medical research, microbiology, industrial chemistry, and biotechnology. In addition, France has ordered its publicly financed research agencies to re-allocate 10 percent of their 1997 budgets and 20 percent of their 1998 funds to R&D programs in the six priority areas.

Other efforts to stimulate commercially relevant technology development in the public sector include new patent policies. French public sector researchers will now be entitled to 25 percent of the commercial royalties arising from their patents. And six major publicly financed research agencies have formed a "Research and Innovation Consortium." This links 10,000 researchers to promote cooperative research and accelerate and enhance the innovation process.

In addition to these efforts, the French government employs several mechanisms to promote the development of technologies by or in partnership with industry. These include:

- Civilian R&D tax credit
- Cooperative government/industry projects to develop generic technology
- "Technological Leap" Program to finance demonstrations of pre-competitive industrial technologies on a cost-shared basis with industrial partners
- "Large innovation projects" target technology development in priority sectors (advanced materials, pharmaceutical raw materials, intelligent manufacturing, transport, and others)
- Large interministerial technology development programs (clean vehicles, ultra-clean food processing, water treatment, and road safety)

Special attention is being directed towards small and medium-sized enterprises (SMEs) to promote private sector technology and diffusion efforts such as:

- The Ministries of Industry and Research announced initiatives to encourage innovation among SMEs in May 1996;
- $200 million was designated to fund development proposals in 1997 and 1998 within pre-approved "key" technology areas; and
- ANVAR technology diffusion centers are directed to target public funds toward key technologies.

NOTE: All U.S. dollar figures are in current dollars using currency exchange rates unless otherwise noted.

GERMANY

After a period of consistent increases in public R&D spending, the German government recently reduced its public R&D expenditures and instituted new policies to make research more competitive and focused on industry goals. However, it still leads Europe in non-defense government R&D investments. Considered in the context of a few recently instituted programs, Germany is clearly increasing its emphasis on technology development and diffusion. German R&D goals include:

- Supporting selected high-technology sectors
- Building an S&T infrastructure in the eastern areas
- Promoting basic research

Following a series of modest but steady increases in public R&D spending over the past few years, the 1997 budget for the Federal Ministry of Education, Science, and Research (BMBF) was cut by 5.6 percent. Taken against a 2.5 percent reduction in the German federal budget overall, this has forced a reformulation of public sector R&D policies. In response to the funding reduction, Research Minister Ruettgers has proposed revamping federally financed science programs and grants to make them more competitive and to orient research conducted by Germany's national labs closer to industry's goals. Additionally, Germany is closing its civilian space agency (DARA) and shifting resources toward commercial aviation programs, such as the development of a new "jumbo" Airbus. Despite budget cuts, funding for key projects in biotechnology and multimedia has remained steady.

Several cooperative technology development and diffusion programs have been launched in cooperation with the private sector. The Chancellor's Council for Research, Technology, and Innovation, established in 1995, includes representatives from industry, trade unions, and research institutes. Its goal is to address obstacles to innovation in priority areas. Its first public report, emphasizing information and communications technologies, was entitled, *Info 2000: Germany's Road to the Information Society.*

Germany continues to be active in encouraging technology diffusion in its eastern areas, where it has launched 21 technology transfer centers and 11 sector-specific technology centers. In 1996, the German government and industry associations combined efforts to form the International Environmental Technology Center (ITUT) in Leipzig. ITUT has joined forces with German companies to recapture global competitiveness in environmental technology. Germany has budgeted $7 million to fund this five-year program.

Unlike public sector spending, German industrial R&D is expanding. In absolute terms, industrial R&D spending rose 1.8 percent in 1995, with impressive growth of 4.5 percent demonstrated among small and medium-sized enterprises. Total German R&D rose 2.5 percent to $54 billion in 1995. More remarkably, German R&D conducted abroad continues to increase. This is attributable both to the globalization of German companies and to restrictions on biotechnology research at home. Between 1991 and 1995, annual funding for German R&D conducted abroad rose by 40 percent.

The German government also finances technology research through the Fraunhofer Society, a non-profit organization of 48 institutions (and 12 associated organizations) that perform contract research for government and industry. Each Institute specializes in one of eight technology areas. The annual amount of public funding averages one-third of total revenues and enables each Institute to obtain state-of-the-art technology and engage in long-term strategic research. In 1995, Fraunhofer served more than 1,400 customers from industry (250 foreign) generating revenues of $850 million.

Since the mid-1990s, Fraunhofer has been establishing a presence in the United States. Fraunhofer USA states that it is an independent organization within the Fraunhofer organization and its "primary objective is the promotion of the technological competence of U.S. manufacturing industry through technology development, technology deployment and new modes of training and education in engineering." However, the 1995 Annual Report of Fraunhofer Germany states: "An essential premise of all activity abroad is concrete benefit for the German Fraunhofer-Gesellschaft or Germany as a whole. The research establishments abroad are thus always directly associated with one of the Fraunhofer Institutes, which is responsible for ensuring a balance between benefit and risk."

UNITED KINGDOM

British science and technology policies remained fairly consistent in 1996. In November 1996, the British government unveiled budget proposals which froze science spending at $2.1 billion, a 2.5 percent reduction in real terms. Despite this proposed reduction in 1996-1997 public R&D expenditures, Britain remains committed to policies that promote technology-based economic competitiveness. To this end, Britain has launched new initiatives in technology diffusion to raise technological levels in key areas. These new initiatives include:

- The Biotechnology Means Business Program
- The Environmental Best Practices Program
- The National Strategic Technology Acquisition Program (in civil aeronautics)
- The Microelectronics in Business Program and Parallel Applications Program (information/computing)
- The Action for Engineering Program (links engineers, industries, and educational institutions)

The Department of Trade and Industry's proposal to privatize many public R&D facilities has drawn expressions of concern from the British scientific community. Recently, the government announced that the privitazation effort had been completed, and that 28 publicly-funded research institutes would remain in the public sector. The implications of the government's action and subsequent debate for technology policy are unclear.

The U.K. continues to place strong emphasis on linking public and industrial R&D. Under the "Technology Foresight" and "Forward Look" frameworks, the government regularly projects science, engineering, and technology policy for a five to ten-year period. A National Technology Foresight Program brings scientists and industrialists together to assess significant emerging technologies and market opportunities. The U.K. government also directly supports several public/private research partnerships:

- The LINK Program partners with private companies and research institutions to encourage pre-competitive R&D for early-stage technologies. The government has invested over $350 million — providing up to 50 percent of the funding for these projects.
- The Advanced Technology Programs (ATPs) speed the development of key technologies, including robotics, superconductivity, undersea technology, and advanced information technologies. The U.K. has devoted several million dollars to the ATPs.
- SPUR (Support for Products Under Research) and SMART (Small Firms Merit Award for Research and Technology) assist small companies in moving products from research to commercialization. The British government also sponsors other initiatives to increase the access of small and medium-sized firms to new technologies.

CZECH REPUBLIC, HUNGARY, AND POLAND

Central Europe Increases S&T Spending Cautiously

The Czech Republic, Hungary and Poland all have recognized, to varying degrees, that strategic S&T planning and the formulation of innovation strategy play a particularly important role in an economy undergoing radical transition. However, the immediate problems caused by economic reform are conspiring to keep investment in science and technology at a minimum. The most serious problems include: low research salaries that are causing a "brain drain" to other countries and industries; private sector concern with survival rather than R&D; and political instability.

CZECH REPUBLIC

At the time of the 1989 Velvet Revolution, total R&D expenditures for the former Czechoslovakia (from state budget and enterprise resources) were 4.9 percent of GDP, the state budget being responsible for 1.8 percent of that total. In 1994, total Czech R&D expenditures were 0.42 percent of GDP, a short-term, negative result of the Czech government's economic reform strategy. As the economic situation stabilizes, R&D expenditures are expected to begin increasing.

The Czech government's S&T policy as outlined in 1994 specifies the creation of an effective system of R&D that would significantly reduce state intervention into creative efforts and would create conditions for advancing university level R&D. Simultaneously, the government is gradually increasing its R&D expenditures using the European Union (EU) as a base for comparison. Its goal is 0.7 percent of GDP, with the following priorities:

- 20 percent for basic research;
- 60 percent for targeted research;
- 5 percent for the development of products and technologies:
- 7.5 percent for the development of research infrastructure; and
- 7.5 percent for international exchange programs.

State support of R&D focuses on two types of funding: target-oriented and institutional. Target-oriented funding is composed of grant projects proposed by organizations or individuals and program-oriented projects ensuing from government principles of R&D support. Institutional funding supports statutory research organizations, their operations, wages and investment policy. Since 1993, the budgets for both institutional and target-oriented funding have risen, with the 1996 proposed budget for targeted funding double its 1995 allotment.

Specific Policy Initiatives

- TECHNOS aims to expand and increase the technological knowledge of small- and medium-sized enterprises by supporting both innovation and the transfer of technology.
- PARK supports the establishment of S&T parks, in particular, investment in equipment for labs and facilities.
- The Technology Innovation Center (TIC) was established in 1994 as an incubator and technology transfer center for small, science-based companies. Enterprises accommodated at TIC work in the area of environmental technology, biotechnology, informatics, computer science, food chemistry and the design of special electronic devices.
- The Czech Republic is a member of the European Union's EUREKA and COST, which assist in the integration of R&D organizations within European structures. They also participate in the European Union's Fourth Framework Program and the NATO Scientific Council.

HUNGARY

Hungarian R&D is managed by the National Committee for Technological Development (OMFB) which also oversees all collaborative S&T programs. The Hungarian government provides 70 percent of the national R&D funds. As a result of reduced government subsidies and overall economic recession since 1989, total spending on R&D has been reduced by half, with industry spending dropping more sharply than government spending. Present combined public and private sector spending is at 0.8 percent of GDP, down from over 2.0 percent in 1988. The government hopes to recover some lost ground by raising the current level of support to 1 percent of GDP by 2000.

Hungarian government priorities for S&T include environmental technologies, biotechnology, information and communications technologies, materials sciences, energy and resource saving technologies, pharmaceuticals and fine chemicals, and agriculture and food processing. Government infrastructure investments have targeted information technology.

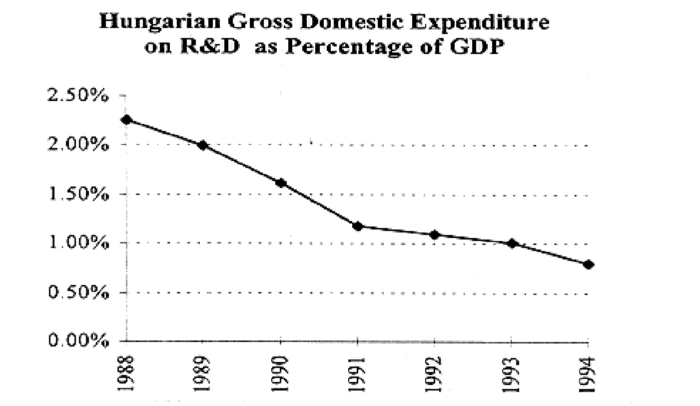
Government policies not only encourage domestic R&D, but also the transfer of foreign technologies. The government has targeted telecommunication, autos and chemicals for technology transfer.

Hungary continued—

Specific Policy Initiatives

- **Applied R&D Competition:** This "bottom-up" funding scheme is aimed at supporting applied R&D technology development ideas and project proposals. The funding comes in the form of grants and preferential loans depending on the degree of risk involved.

- **Target Oriented Competition:** This "top-down" funding scheme is designed to serve the government's priorities in specific areas. In 1994, the following "national projects" were funded: Geographic Information Systems, $5.6 million; Disposition of Low and Medium Activity Nuclear Wastes, $1.3 million; Food Processing, $2.5 million; Automobile Industry Suppliers, $1.9 million; Machinery for Agriculture and the Food Processing Industry, $3.1 million.



Source: OMFB

POLAND

As a result of reduced government subsidies and overall economic recession, Poland's R&D budget has been cut significantly. Measured in relation to GDP, total R&D funding in Poland is relatively low when compared to other countries at a similar level of economic development. Combined government and industry R&D expenditures were highest in 1988 at 2.2% of GDP, but have fallen to 0.8 percent of GDP. State funding of R&D has also fallen to precariously low levels, 0.55 percent of GDP in 1993.

The economic transformation has brought about changes in the financing of R&D and introduced new factors: competition, orders for R&D under precisely determined conditions, and quality control. All R&D budgets and coordination responsibilities were given to the State Committee for Scientific Research (KBN) in an attempt to streamline S&T policy initiatives. The KBN has identified particular research and industry strengths in Poland. These include chemicals, production of precision instruments and apparatus, engineering, building materials, and food processing.

The Polish government has stated that the following are its S&T priorities for 1994-1997:

1. Health and environmental protection;
2. Agriculture and food processing;
3. High tech industries, including defense; and
4. Infrastructure development of science, education and technology transfer.

The government has also pledged specific support for:

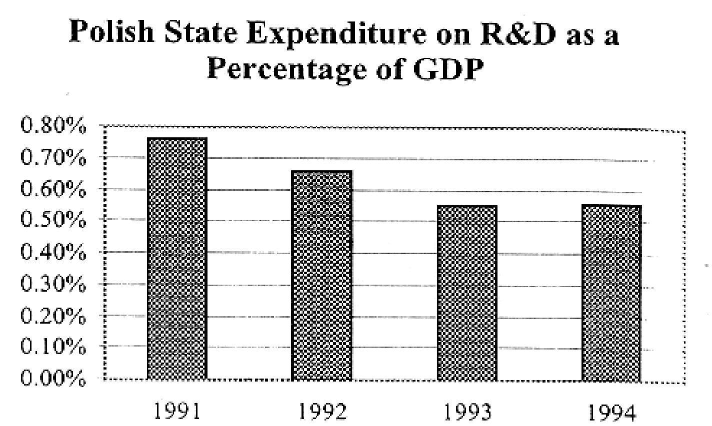
- materials technology and biotechnology;
- information technology infrastructure and software used in management, telecommunications, science, public services, design and manufacturing;
- biological sciences, medical sciences, agricultural sciences; and
- economics and management.

Specific Policy Initiatives

In November 1994, the Polish government approved its "Guidelines for Innovation Policy." These guidelines outlined a number of incentives and regulations designed to spur the growth of innovation. Since then, a new government has come to power and many of these incentives have not been implemented. The policy tools that are in place to stimulate S&T activity are:

- Statutory funding takes the form of block research grants to research institutions;
- Goal-oriented projects support innovation in economic entities by co-financing research designed to achieve results that will be used in production. Implementing entities cover at least 35 percent of all research costs and costs involved in bringing the results to production;
- Investments in R&D infrastructure consist of capital grants for the construction of research facilities and their instrumentation; and
- Two percent of the KBN budget supports international scientific cooperation stemming from intergovernmental agreements.

The number of Polish foundations willing to support S&T activity has grown rapidly in recent years. Some, such as the Foundation for Polish Science and Stefan Batory's Foundation, have become important sources of science financing.



Source: KBN, The Polish State Committee for Scientific Research

CANADA

Canada Maintains Support for Technology Despite Budget Resolutions

Canada's total research and development spending for 1996 was approximately $9.5 billion. It is estimated that Canada's business sector performed 62 percent , higher education 22 percent, and the federal government 12 percent. This reflects the trend in which the Canadian federal government has become relatively less involved in both the funding and performance of R&D while the business sector has become relatively more involved in both activities.

At 1.59 percent of Gross Domestic Product in 1996, Canada's R&D ratio is lower than that of all G-7 countries, except for Italy. In part, this is due to low levels of defense R&D expenditures.

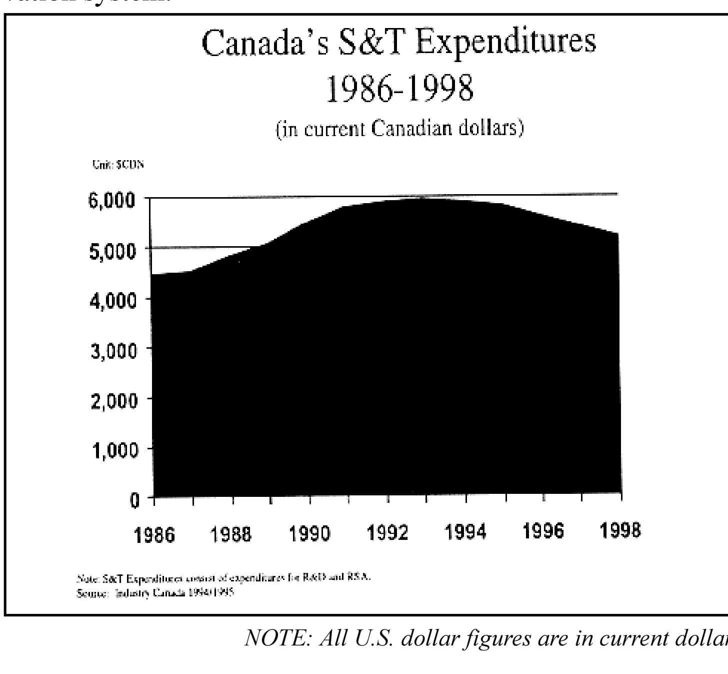
FEDERAL GOVERNMENT S&T ACTIVITIES

Support for science and technology remains a priority in Canada despite fiscal constraints on spending. In addition to Canada's $4.13 billion budget for 1995-1996, the government also provides considerable indirect S&T assistance to the private sector through the Scientific Research and Experimental Development tax credit. This assistance amounted to over $750 million in 1992.

The core framework outlining the federal government's S&T activities are:

- Funding and performing scientific research to support the mandates of departments and agencies
- Supporting research in universities, hospitals, and other non-government research facilities and Networks of Centres of Excellence
- Supporting private sector R&D

In addition to these traditional activities, the government is increasingly pursuing the role of information analyst and knowledge disseminator and network builder. This role is seen as being critical to the successful evolution of the Canadian innovation system.



NEW AND REALLOCATED FUNDING

S&T programs and projects supported by new or reallocated funds in 1996 include:

- Technology Partnerships Canada, a program of government-industry partnership, leverages investment in higher technology products and processes, and encourages commercialization through partnerships and risk-sharing with the private sector. By 1998, the TPC annual budget is expected to grow to $180 million. Aerospace is a principal focus. The Canadian government intends to maintain jobs in this sector, which it sees as facing heavily subsidized foreign competition.
- Long-Term Space Plan focuses on meeting Canadian needs and spurring economic growth and employment.
- CANARIE -the Canadian Network for the Advancement of Research, Industry, and Education, accelerates construction of the Information Highway.
- School Net links Canada's public schools, libraries, colleges and universities to the Information Highway.
- Health Intelligence Network seeks to strengthen Canada's national surveillance and disease-monitoring capacity.
- MRC-PMAC Health Program stimulates health research with a high ratio of private sector investment.
- TRIUMF is Canada's largest particle physics laboratory.
- Western Economic Diversification's Canada Biotechnology Partnership engages financial institutions in improving access to capital for small businesses in emerging industries.
- PRECARN is a non-profit industrial consortium involved in collaborative, pre-competitive R&D on intelligent systems.
- Agriculture and Agri-food Canada's Matching Investment Initiative co-funds projects with industry to ensure that research priorities are met and technology is transferred.

Federal Support for Private Sector Research & Technology Development

Over the years, the federal government has had various programs to promote increased R&D activity in the private sector. These programs include general support through the tax system, support for industry-led consortia in pre-competitive research, and firm-specific technology development assistance for high-risk commercialization.

The foremost example of the government's strategic approach for innovation is the National Research Council's Industrial Research Assistance Program (IRAP). Through partnership with organizations across Canada, IRAP has created a national network of technology advisors to help Canadian companies in their own communities acquire, develop, and exploit technology from across Canada and around the world.

IRAP provides technical advice to over 10,000 companies per year and, where necessary, financial support for R&D activities. The program is delivered coast-to-coast through a network of 260 Industrial Technology Advisors and involves 130 members representing provincial research organizations, research centers, universities and colleges, and industrial associations.

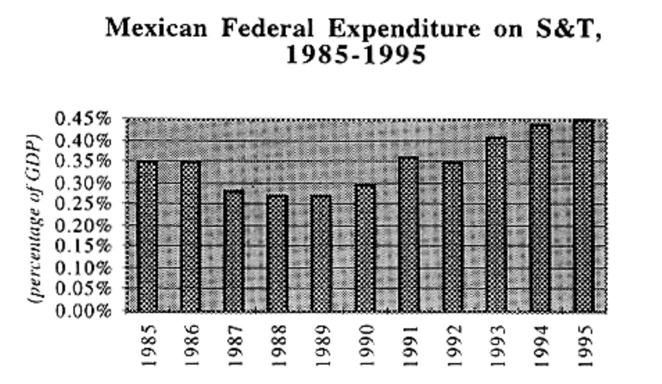
MEXICO

Science and Technology Weathering the Storm of the Peso Crisis

Despite the economic downturn caused by the peso crisis at the end of 1994, the Mexican government has explicitly avoided the drastic science and technology (S&T) cuts of the early 1980s that decimated Mexico's research establishment. As the economy recovers, the Mexican Government is looking to S&T investments to provide an engine for growth.

In 1996, President Zedillo presented a new S&T policy that formally outlined the critical role S&T will play in meeting Mexico's primary objective, sustainable development. President Zedillo has committed to double the national S&T expenditure to 0.7 percent of GDP, conceding that Mexico's economic performance will have a bearing on this goal.

Total Mexican S&T expenditures grew significantly from a low in 1987 ($300 million) through 1994 ($722 million), though private sector expenditures have generally been modest by international standards. Economic conditions during 1995 made it impossible to sustain the pace of the early 1990s. Since 1989 Mexico's S&T budget has increased substantially; in 1989 the S&T budget was 230 million old pesos and, in 1994, 902 million new pesos, a 230 percent increase in real terms. In 1995, however, Mexico's investment in S&T only represented 0.45 percent of GDP. While CONACYT's (the national agency in charge of promoting, implementing and coordinating the S&T policies of the federal government) budget has increased by 20 percent in nominal terms, it has decreased by 8 percent adjusting for inflation.



Source: OECD

FEATURES OF PRESIDENT ZEDILLO'S S&T PLAN

- Achieve a significant advance in S&T development during the Zedillo administration;
- establish close cooperation between the government and private industry;
- stimulate the decentralization of the national S&T system to improve the quality of scientific activity;
- promote ties between scientific and social activities; and
- improve coordination in S&T programs between agencies.

President Zedillo's S&T plan specifically supports mega-science projects, including the LMT, the large millimeter microscope that represents a major commitment to building the S&T infrastructure of Mexico. Other large projects include the computer science program and the establishment of a network of standards and metrology labs. President Zedillo will also support the Mexican S&T establishment by raising funds abroad.

Specific S&T policies include:

- seek another loan from the World Bank to strengthen and expand the existing scientific infrastructure;
- promote research and academic activities with the industrial sector which stimulate ties between scientific activities and industry;
- strengthen direct incentives to young researchers and to include them in the national researchers program;
- develop new technology policies which eliminate market imperfection and confront difficulties caused by other economic policies;
- promote cooperative research and the development of quality standards with foreign industry or research centers;
- assist companies to obtain financing to improve technological capacity and comparative advantage of competitive strategies;
- stimulate industrial capacity to utilize efficient technologies, create new products, and adapt to market changes;
- establish a network of standards and metrology centers to ensure industrial quality;
- improve relationships between research and industry;
- increase the participation of universities in technology management;
- stimulate the creation of competitive assistance centers managed by industry associations or academic institution; and
- promote the use of fiscal stimuli and establish additional incentives to increase spending on technology innovation.

SPECIFIC POLICY INITIATIVES

- **PACIME:** This Support Program for Science in Mexico is partially financed by the World Bank. Its main objectives are to strengthen Mexico's research infrastructure; to promote the integration of research groups and support joint research projects; to assist the process of decentralization of science in Mexico; and to promote the creation of links among researchers in basic and applied projects.

NOTE: All U.S. dollar figures are in current dollars using currency exchange rates unless otherwise noted.

- **University-Industry Link Programs** was established in 1992 to bridge the gap between R&D and its industrial applications. This program brings together both private industry's demand for pre-commercial technology and the Mexican university system's R&D potential. The program covers projects that involve human resource development in areas of industrial interest, joint research, and joint commercialization of successful research results. Between 1992 and 1995, the U-IL programs have supported 115 projects.

- **Program of Technology Firm Incubators'** main objective is to foster the creation of start-up companies whose common denominator is the use of advanced technology. The incubators are normally anchored by one or more research institution able to provide scientific advice and tutoring to firms, as well as access to well-equipped labs. In two years of operation, CONACYT has established 13 regional incubators with an average participation of approximately 1 to 1.5 million new pesos per project. Total resources in the program surpass 19.7 million new pesos (approximately $2.6 million).

- **FIDETEC**, the R&D Technological Modernization Trust Fund, was established in 1992 and is designed to provide guarantees and long-term financing for pre-commercial R&D in firms. Conceived of as a second-tier financial institution, FIDETEC normally operates via commercial banks and financial intermediaries. As such, it provides all the benefits of risk capital, since the government shares the risk with the entrepreneur. At the same time, it places projects under close scrutiny and financial market discipline, by operating via commercial loan guarantees.

AUSTRALIA

A New Government Means New Incentives for S&T Development

Australia is taking full advantage of its position in the Asia-Pacific region and its world class R&D infrastructure to improve its international competitiveness. It is investing heavily in its S&T base, emphasizing the aerospace and environmental technology sectors, while making impressive additions to its traditionally superior mining and agricultural fields. Australia attracts a broad base of international R&D activities by promoting itself as the low-cost, high return, gateway to the Asia-Pacific. The Australian government believes it must not only invest in its technological competitiveness, but must continue to create incentives for private industry to invest as well. The new coalition government, elected in March of 1996, has maintained the priority of international competitiveness but with a far stronger emphasis on industry involvement.

Australian S&T policy has pursued 3 main objectives over the past decade: maintaining a high quality public sector research infrastructure, maximizing the practical application of the science base to industry and encouraging greater innovation by business. The Federal government's central role in funding R&D has led it to develop institutional arrangements aimed at ensuring that these objectives are met. One of these institutions is the Australian Commonwealth Scientific and Industrial Research Organization (CSIRO), the largest Australian organization performing R&D. CSIRO's central focus is on encouraging better links between public sector research and industry. Its specific functions include performing R&D, encouraging and facilitating the application of the results of the R&D, and acting as a liaison between Australia and other countries in matters connected with scientific research.

In 1993-1994, Australia's total expenditure on R&D was 1.58 percent of its gross domestic product, ranking it at number 11 in the world. Australian federal expenditures on R&D were 0.87 percent of GDP for the same time period. Business spending on R&D in Australia has trebled as a share of GDP over the past 12 years, jumping from 0.23 to 0.71 percent of GDP in 1993-1994. As the business sector has been historically weak in its spending on R&D, this trend has been widely celebrated.

STRONG S&T SECTORS

Traditionally, Australia has been very strong in a number of areas of public sector research, including agricultural studies, biology, medical research, mining and astronomy. The government is putting strong support behind Australia's space programs in an effort to maximize future benefits to the country and commercial applications to industry.

SPECIFIC POLICY INITIATIVES

The new government has budgeted funds to build two more Cooperative Research Centers in 1997-1998. The CRC program is a key mechanism encouraging tripartite R&D linkages between government research agencies, universities and industry. As a major participant in CRCs, industry will contribute A$400 million (USD $319 million) or approximately 20 percent of the total provided by participants. At this time, over 200 companies are involved in the CRC program, including several leading international companies. 62 centers are in operation now:

- 9 manufacturing technology centers;
- 8 information and communications technology centers;
- 10 mining and energy centers;
- 15 agriculture and rural based manufacturing centers;
- 12 environment centers; and
- 8 medical science and technology centers.

START, a new program of strategic R&D assistance, aims to:

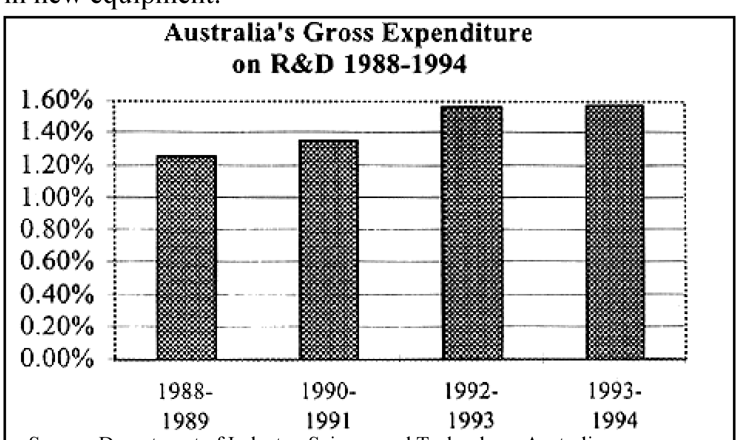
- increase the number of R&D projects with high commercial potential undertaken by firms,
- improve the rate of the commercialization of such high return projects and
- increase the private sector investment in R&D.

This program replaces the old R&D Syndication Program, deemed ineffective by the new government.

A 125 percent tax incentive for industrial R&D has replaced the old 150 percent tax incentive. While this program has stimulated increased business R&D expenditure and increased innovation overall, the new government felt 150 percent was too high for the government budget to carry.

The new government has maintained funding for the Science, Engineering and Technology Awareness Program whose aim is the promotion of S&T and the diffusion of scientific information to the public.

The new government is also spending A$90 million over the next three years to improve the R&D infrastructure and invest in new equipment.



Source: Department of Industry, Science and Technology, Australia

The United States Department of Commerce

Technology Administration

BRAZIL, CHILE, AND ARGENTINA

Latin American Nations Place New Emphasis on Science and Technology

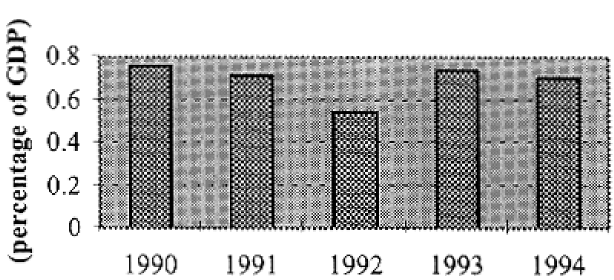
Brazil and Chile have maintained a focus on technological development goals and continue to implement strategies of investing in science, technology and innovation to fuel its growth. In contrast, Argentina is a promising market, but due to its economic transitioning over the past five years, it has let S&T spending slip, creating daunting challenges for the future.

BRAZIL

In 1995, Brazil's GDP exceeded $552 billion, the largest economy in the region and the 9th largest in the world. Brazil also has the largest and best developed industrial base in Latin America. It has the greatest number of scientists and technicians, many of whom are employed in over 500 research institutes and 100 Federal, State and private organizations involved in S&T activities. S&T spending by the federal government has remained steady through the 1990s, making up 57 percent of national expenditures, a total of $2.2 billion in 1994. Total national expenditures in 1994 were 0.70 percent of GDP.

Brazil's Ministry of Science and Technology implements the nation's S&T policy and coordinates priority areas and R&D activities involving the development, production and application of new and advanced technologies. Brazil's priority areas are information technology, biotechnology, and informatics.

Total Brazilian S&T Expenditures as a Percentage of GDP



Source: The Brazilian Ministry of Science and Technology and CNPq

Specific Policy Initiatives

Brazil is encouraging industry and private sector enterprises to invest in R&D with Brazilian research institutions through tax write-offs. Five years ago the state was responsible for 100 percent of the funding of R&D. Today, the private sector is responsible for close to 20 percent of the funding.

CNPq, the National Research Council, coordinates basic programs devoted to strategically important fields and maintains special programs, including the Support Program for Industrial Competitiveness, the Environmental Technology Development Program, and the Software Technology Development Program.

Brazilian industry has also been active in establishing R&D centers, as well as upgrading quality standards to internationally competitive ISO 9000 standards. The Brazilian government supports such activities under the Brazilian Quality and Productivity Program (PBQP) and it regulates technology transfer through such mechanisms as the National Institute for Industrial Property (INPI).

CHILE

Based on the exploitation of its natural riches and on the expansion of related industrial sectors, Chile's economy has enjoyed continuous growth over the past decade, with a GDP growth rate averaging seven percent per year. The annual rate of inflation has fallen from 40 percent in 1985 to six percent in 1995. Exports in 1994 were 6.5 times those of 1985, and more than one hundred new markets have been opened for Chilean products in the past decade.

These economic improvements have had an impact on national expenditures on R&D, which have expanded from 0.61 percent of GDP in 1990 to 0.8 percent in 1994. Modernization, innovation and flexible systems and structures, accompanied by pervasive dissemination and absorption of new technologies, are perceived as key factors in meeting the country's economic targets for the coming decade. One of these targets is raising R&D expenditures to 1 percent of GDP by 2000.

Research is centered in about 400 units in 23 states and 38 private universities. The most developed S&T fields are agriculture and forestry, Antarctic science, astronomy, biology and biotechnology, earth sciences, marine and fisheries sciences, medicine, and theoretical physics. The fastest growing areas of research are biotechnology and computer science. Chile's rapid expansion of the "information highway" is particularly notable. Chile transacts almost twice as many Internet communications with the United States and Europe as do all other Latin American countries combined. It is using this experience to expand commercial ventures into electronic commerce to become a leader in this area as well.

The government has set up a Presidential commission to stimulate the development of S&T throughout Chilean society. As part of an effort to encourage Chilean scientists to work in Chile, a series of substantial grants limited to a small number of scientists has been established. In its first year, it granted a total of $1.5 million to 12 researchers.

NOTE: All U.S. dollar figures are in current dollars using currency exchange rates unless otherwise noted.

Chile continued—

Chile is also developing a "partnering with industry" mechanism in which research costs and benefits are jointly shared by government and industry. The program allows Chilean firms to engage domestic and foreign partners in R&D projects. Over its first 3 years, this program has invested $30 million.

The government of Chile has defined a national S&T program based on three national funds:

FONDECYT: the National Fund for Scientific and Technological Research is aimed at funding research projects in basic and applied sciences, in all fields of knowledge, based only on excellence. The research projects may be up to 3 years in duration and are presented and performed mainly by universities.

FONDEF: the National Fund for Fostering Scientific and Technological Development was created in 1991. Its purpose is to finance joint projects between the scientific and manufacturing sectors targeted at increasing Chile's competitiveness in areas key to its development and in which results may be transferred in the short term to industry. The following priority areas have been defined: Agriculture, Fisheries and Aquaculture, Forestry, Mining, Informatics, and Manufacturing Industries. The projects are submitted by research institutions and funds are awarded through open competition. These joint efforts facilitate the diffusion of research results and in doing so achieve economic and social benefits.

FONTEC: the Fondo de Desarrollo Technologico's main objective is to support research programs carried out by enterprises and to subsidize the creation of research infrastructure within the industrial sector.

ARGENTINA

In 1991, Argentina launched an economic austerity program, severely restricting government spending in an effort to create a stable economy for the long term. This program included complete privatization of state-owned enterprises, a process basically complete by mid-1995. However, 1994-5 brought the Mexican peso crisis and Argentina's GDP, which had been rising through the 1990s at an average rate of 6 percent, diminished to a growth rate of only 1 percent in 1995.

Even before the peso crisis, however, government S&T spending in Argentina had been declining. In 1995, spending for S&T amounted to $767 million, or 1.8 percent, of the total federal budget. The S&T budget has increased overall from 1994, but only as a consequence of including the $227 million nuclear budget, which itself will be vastly reduced as elements of the nuclear industry are spun off in preparation for privatization.

Within the S&T budget, $205 million goes to CONICET, the National Council for Scientific and Technical Research, which through a system of grants and scholarships supports both basic and applied research. The top 5 fields of research are medical sciences, biology, chemistry, earth sciences, and physics.

Argentina also emphasizes the importance of three other S&T sectors: environmental technology, Antarctic research and atomic energy. Environmental spending alone will be $107 million, representing a $22 million increase over last year. Antarctic research and military S&T are both funded through the defense budget, receiving a total of $19 million and $23 million respectively. Centro Atomico, the atomic energy labs, is stressing the commercial promise of the materials processes and software it develops. Centro Atomico is attempting to cover 30 percent of its budget with private contracts amounting to about $5 million.

SOUTH AFRICA

New Government of National Unity Re-Energizes S&T Policy

From a developmental standpoint, South Africa is a unique hybrid of first- and third-world societies, but its S&T capabilities fall squarely in the first category. In some areas, including atomic energy and mining technology, its industrial and scientific prowess matches, and even exceeds, that of many other developed nations. Nonetheless, noticeable shortcomings exist in other fields, caused in large part by South Africa's isolation during an era of increased international cooperation activity elsewhere.

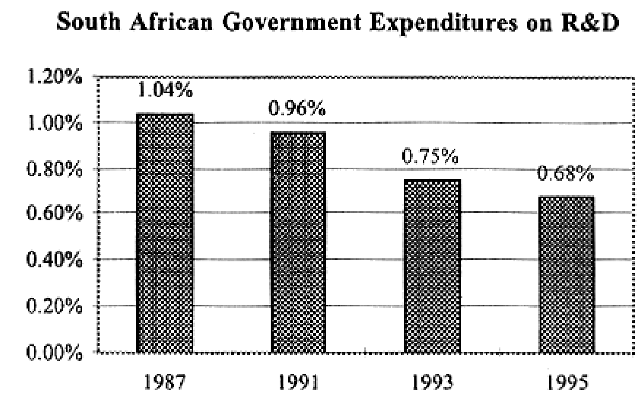
Under its new Government of National Unity, South Africa has initiated a $10.5 billion, 5-year (1994-1999) Reconstruction and Development Plan (RDP) which will include the restructuring of South Africa's science and technology institutions. Both the government and the scientific community are adapting to new national priorities outlined in the RDP. New policies and strategies are being formulated on how to effectively serve the needs of the new South Africa, and how best to reintegrate South Africa into the international community.

The South African government, through the Reconstruction and Development Plan, (RDP), is seeking an annual economic growth rate of 6 percent. As a country which is currently under-investing in S&T and innovation, South Africa believes this target will require a greater than 6 percent annual growth rate in the national investment in these activities. In particular, those sectors destined for export growth might not achieve their targets if this investment does not occur. Throughout 1995 and 1996, the government has been developing a far-reaching S&T policy based on a national system of innovation to spur this growth.

Compared to most developed countries, South Africa spends very little on R&D as a percentage of GDP. In 1991, it was only 0.96 percent of GDP, a decline from its height in 1987 of 1.04 percent of GDP. However, if viewed as a developing country, such levels of government support are typical. As the new government struggles to deal with expanded demands for social and physical infrastructure improvements, fiscal constraints have hampered South Africa's ability to maintain its status as leader in technological innovation. R&D expenditures fell to 0.68 percent of GDP in 1995.

Currently, the bulk of the financing for R&D in South Africa comes from the central government. For 1994/1995, roughly $104.4 million were allocated for general R&D, and $190 million for specific R&D. However, given that R&D funds also are subsumed in the individual budgets of each Ministry (e.g. Education and Agriculture), total R&D expenditure is extremely difficult to quantify. The responsibility for academic and applied research lies mainly with the 21 universities, 7 scientific councils and 15 technikons (technical centers). The scientific councils, which are funded by the state via parliamentary grants and by public and private contracts, perform the lion's share of applied research.

In South Africa, 56 percent of all expenditures on R&D are incurred in the private and state-owned industry sector. Traditionally, firms have been protected in the domestic marketplace, the government limiting competition and therefore the need to innovate. This, along with the economic stagnation in late 1980s, conspired to diminish private sector R&D expenditures.



Source: South African Government

SPECIFIC POLICY INITIATIVES

- **Support Program for Industrial Innovation** (SPII) supports innovation in firms on a matching grant basis and has recently been broadened to include support for patent registration for products/processes developed with SPII support. Awards can be as much as 50 percent of the total cost of R&D, up to a maximum of R1 million, and are made in the form of cash payments after the work has been completed. The government has proposed a considerable increase in funding for this program over the next 2 years.
- **The Innovation Fund (IF)**, as proposed, will take the lead in encouraging and enabling large, long-term innovation projects in the higher education sector, government science and technology institutions, civil society and the private sector. The objectives of IF are:
  - to permit a reallocation of government resources from the historical patterns towards the key issues of competitiveness, quality of life, environmental sustainability and harnessing information technology;
  - to increase the extent to which funds for the activities of government S&T institutions are obtained via competitive processes; and
  - to promote increased networking and cross-sector collaboration within South Africa's national system of innovation.

NOTE: All U.S. dollar figures are in current dollars using currency exchange rates unless otherwise noted.