

09 Science and Technology

Science and Technology Spending

Japan's scientific and technological activities have traditionally relied mainly on heavy private-sector investment for research and development. Corporate R&D spending fell for two straight years from fiscal 1993 in response to the sagging economy but started to increase again in 1995. Overall R&D spending also rebounded dramatically in fiscal 1995, hitting a record figure of ¥14.4 trillion, and increased constantly from then to ¥17.8 trillion in fiscal 2005.

November 1995 saw the enactment of the Science and Technology Basic Law, which aims to stimulate original basic research, cites activities in those fields as a national obligation, and requires national and local government policies to promote research and development. In January 2001, as part of the administrative reform, the government established the Council for Science and Technology Policy in the Cabinet Office, which, under the chairmanship of the prime minister, formulates the nation's science and technology policies. In March 2006 the government decided on the third Science and Technology Basic Plan covering fiscal 2006 to 2011, which sets the scope of the total government R&D budget for those five years at ¥25 trillion. It also designated four primary prioritized areas: life sciences, information technology, environmental sciences, and nanotechnology and materials; and four secondary prioritized areas: energy, technological craftsmanship, infrastructure, and frontier (outer space and ocean).

Government's Science and Technology Budget

FY	Science and technology budget (¥ billion) ^a	Increase over previous year (%)	Share of initial general account budget (%)
1995	2,499.5	6.0	3.5
2000	3,286.0	4.1	3.9
2001	3,468.5	n/a	4.2
2002	3,544.4	2.2	4.4
2003	3,597.4	1.5	4.4
2004	3,608.4	0.3	4.4
2005	3,578.5	- 0.8	4.4
2006	3,574.3	- 0.1	4.5
2007	3,511.3	- 1.8	4.2

Source: Ministry of Education, Culture, Sports, Science and Technology; Ministry of Finance.
Note: With the implementation of the Science and Technology Basic Plan in 1996 and 2001, the items covered by the science and technology budget have been enlarged from those years.
a. Initial budget.

Spending on Scientific Research by Category, FY 2005

(% of total)

	Basic research	Applied research	Development
Universities and colleges	55.1	35.8	9.1
Nonprofit institutions	20.3	35.8	43.9
Public research institutes	24.4	29.6	46.0
Business enterprises	6.3	19.6	74.1
Average	14.3	22.8	62.9

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2006.

Note: Figures are for natural science only.

Trends in Research and Development Expenditures

(¥100 million)

FY	Japan	USA ^a	Germany ^b	France	UK
1985	88,903	274,797	46,594	28,121	24,611
1990	130,783	220,659	62,755	41,789	30,986
1995	144,082	173,143	49,807	33,748	20,836
2000	162,893	288,573	50,260	30,734	28,949
2003	168,042	339,023 ^b	71,359	45,231	37,575
2004	169,376	338,132 ^b	74,173	47,735	40,292
2005	178,452	n/a	77,247 ^c	49,887 ^c	n/a

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2006.

Note: Figures include research in social science and humanities. Yen equivalents calculated using IMF conversion rates.

a. Calendar year.

b. Figures for 1990 and before are for the former West Germany.

c. Provisional figure.

Research and Development Expenditures by Purpose

(¥ million)

	Space exploration	Information technology	Environmental science and technology	Life sciences	Energy	Materials	Nano-technology
1990 Total	195,144	1,121,200	234,762	1,339,299	913,970	n/a	n/a
1995 Total	268,067	1,129,740	309,750	1,733,092	1,115,825	n/a	n/a
2000 Total	296,383	1,734,107	532,612	1,770,883	983,166	n/a	n/a
2001 Total	245,242	2,252,039	678,688	1,974,314	762,763	275,282	75,273
2002 Total	268,034	2,255,064	679,899	2,069,924	800,808	321,663	88,281
2003 Total	152,957	2,492,096	768,180	2,077,133	849,997	445,888	136,895
2004 Total	225,241	2,592,612	825,176	2,133,283	848,715	496,242	140,701
2005 Total	241,521	2,801,099	894,150	2,352,985	884,472	576,404	193,121
Business enterprises	24,021	2,560,001	682,426	1,236,824	533,733	406,535	120,908
Public research institutes	204,017	78,678	93,668	256,106	245,922	67,189	19,466
Universities and colleges	7,583	144,589	86,696	792,374	51,937	91,126	40,600
Nonprofit institutions	5,900	17,831	31,360	67,681	52,880	11,554	12,147

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2006.

Research Expenditures and Number of Researchers, FY 2005

	Total spending (¥100 million)	Share funded by government (%)	Ratio of spending to GDP (%)	Number of researchers (1,000)
USA ^a	338,132 ^{bc}	31.0 ^c	2.68 ^c	1,335 ^d
Germany	77,247 ^b	30.4 ^c	2.51	268 ^b
Japan	178,452	19.0	3.55	820 ^e
France	49,887 ^b	37.6 ^c	2.13 ^b	200 ^c
UK	40,292 ^c	32.8 ^c	1.73 ^c	158 ^f

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2006.

Note: Figures include research in social science and humanities. Yen equivalents calculated using IMF conversion rates.

a. Calendar year.

b. Provisional figure.

c. 2004.

d. 2002.

e. 2006.

f. 1998.

Nobel Prize and Fields Medal Recipients

	Nobel Prize ^a		Fields Medal 1936–2006
	Total	1946–2006	
USA	222	204	11
UK	74	48	6
Germany	65	29	3
France	26	11	9
Sweden	16	10	1
Switzerland	15	10	0
Netherlands	13	5	0
Former USSR	13	11	6
Japan	9	9	3
Denmark	9	4	0
Canada	8	6	0
Austria	8	1	0
Italy	7	4	1
Belgium	5	3	2
Others	25	19	5
Total	515	374	47

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2006.

a. In physics, chemistry, and physiology or medicine.

Trends in Applications for Patents by Category

	2000	2001	2002	2003	2004
Daily supply	41,113	41,205	40,723	47,399	47,456
Processing operation and transportation	72,291	69,996	66,703	70,223	68,936
Chemistry and metallurgy	41,189	40,881	39,650	46,236	44,379
Fiber and paper	4,969	5,081	4,462	4,780	4,658
Solid structure	18,100	16,807	15,088	14,609	13,808
Mechanical engineering, lighting, heating, weapons, blasting	33,297	33,178	32,368	34,796	34,718
Physics	102,706	103,110	94,918	99,428	103,427
Electricity	88,440	89,361	86,430	93,585	96,623

Source: Japan Patent Office.

Space Development

Japan's space development programs used to be carried out mainly by the National Space Development Agency (NASDA), the National Aerospace Laboratory of Japan, and the Institute of Space and Astronautical Science. Based on a March 2002 report compiled by a government panel to integrate these three organizations, the Japan Aerospace Exploration Agency (JAXA) was inaugurated in October 2003. The government's space development budget in fiscal 2006 totaled ¥251.4 billion, of which ¥180.1 billion was allocated to the JAXA.

Following the first successful launch of the next-generation Japanese-made H-IIA rocket in August 2001, NASDA launched three H-IIA rockets in 2002, paving the way for commercial satellite-launching operations. In March 2003 a fifth rocket successfully released two information-gathering satellites, Japan's first, into orbit. Although the sixth launch in November 2003 with two information-gathering satellites resulted in failure, the tenth rocket in September 2006 and the twelfth in February 2007 successfully placed two additional information-gathering satellites in orbit. The four-satellite unit enables Japan to receive pictures of any place on Earth once a day.

Another important issue is the future of the satellite launching business. In an effort to encourage the commercial launch industry, the government in April 2007 transferred the H-IIA project to Mitsubishi Heavy Industries, Ltd. The fact that 11 out of 12 rockets have been launched successfully, averaging over 90% of the world standard level, is likely to boost the rocket's international credibility. The remaining problem, however, is to cut the cost of launching, which is said to be 30% higher than that of its competitors, such as Europe's Ariane.

In November 2005 Japan's space probe Hayabusa successfully landed on the asteroid Itokawa, 300 million kilometers distant from the Earth. Although the Hayabusa seems to have failed to retrieve surface samples and its return to Earth may be delayed for three years to 2010, some say that its achievement has opened a new page in the era of solar system exploration.

Budget for Space Development, 2006

(¥ million)

	Budget
Ministry of Education, Culture, Sports, Science and Technology	180,308
Cabinet Secretariat	61,150
Ministry of Internal Affairs and Communications	1,640
Ministry of Agriculture, Forestry and Fisheries	128
Ministry of Economy, Trade and Industry	3,591
Ministry of Land, Infrastructure and Transport	3,989
Ministry of the Environment	640
Total	251,446

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2006.

Technology Exchange

Until recently Japan's technology trade balance had long been in the red. According to the Ministry of Internal Affairs and Communications statistics, in fiscal 1970 the country's exports of patents and other technological know-how stood at only one-fifth of its imports. This ratio improved through the 1980s, however, and exports topped imports for the first time in fiscal 1993. Japan ran a ¥1,324.6 billion technology trade surplus in fiscal 2005.

Patent Applications

Foreign Applications in Japan, 2005	Number	Share of total (%)
USA	23,811	40.3
Germany	7,929	13.4
Korea (ROK)	6,845	11.6
Netherlands	4,303	7.3
France	3,180	5.4
Switzerland	2,001	3.4
UK	1,898	3.2
Others	9,151	15.5
Total	59,118	100.0

Japanese Applications in Foreign Countries, 2004	Number
USA ^a	64,812
China	25,542
EPO (European Patent Office)	20,584
Korea (ROK)	14,226

Source: Japan Patent Office.

a. Utility patent only.

Japan's Technology Trade by Country and Region, FY 2005

Exports	Value (¥ billion)	Share (%)
ASIA	642.9	31.7
China	164.4	8.1
Thailand	141.0	7.0
Taiwan	93.9	4.6
Indonesia	56.7	2.8
Korea (ROK)	47.6	2.3
Malaysia	28.9	1.4
NORTH AND SOUTH AMERICA	1,062.2	52.4
USA	883.9	43.6
EUROPE	288.7	14.2
UK	111.4	5.5
France	38.5	1.9
Germany	29.0	1.4
Others	34.5	1.7
Total	2,028.3	100.0

Imports	Value (¥ billion)	Share (%)
NORTH AMERICA	525.4	74.7
USA	522.6	74.3
EUROPE	165.0	23.5
France	27.1	3.9
UK	35.3	5.0
Germany	25.6	3.6
Switzerland	18.4	2.6
Netherlands	17.1	2.4
Others	13.2	1.9
Total	703.7	100.0

Source: Ministry of Internal Affairs and Communications, *Kagaku gijutsu kenkyu chosa* (Survey on Research and Development), 2006.