

09 Science and Technology

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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 three straight years from fiscal 1992 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 ¥16.9 trillion in fiscal 2004.

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 designates 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 (%)
1994	2,358.5	4.1	3.2
1995	2,499.5	6.0	3.5
1996	2,810.5	n/a	3.7
1997	3,002.6	6.8	3.9
1998	3,032.2	1.0	3.9
1999	3,156.7	4.1	3.9
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

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2005.

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 2004

(% of total)

	Basic research	Applied research	Development
Universities	54.3	36.9	8.7
Nonprofit institutions	19.9	38.8	41.3
Public research institutes	25.5	30.3	44.2
Private enterprises	6.0	19.4	74.6
Average	14.4	23.0	62.6

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2005.

Note: Figures are for natural science only.

Trends in Research and Development Expenditures

FY	Japan	USA	Germany ^a	France	UK
1985	88,903	273,746	40,615	28,121	24,249
1990	130,783	220,170	59,681	41,789	30,492
1995	144,082	172,705	51,938	33,748	20,837
1996	150,793	214,656	58,206	38,827	24,452
1997	157,415	256,661	58,486	37,741	29,036
1998	161,399	296,277	64,963	41,220	33,524
1999	160,106	277,390	58,484	35,835	31,278
2000	162,893	285,196	50,259	30,734	28,949
2001	165,280	333,249	56,553	35,765	32,591
2002	166,751	346,621 ^b	62,974	40,745	37,304
2003	168,042	329,004 ^b	71,060	45,231	39,458
2004	169,376	n/a	n/a	47,888 ^b	n/a

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2005.

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

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

b. 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
1998 Total	256,583	1,672,315	382,607	1,564,146	1,103,601	n/a	n/a
1999 Total	287,211	1,734,032	476,884	1,680,785	1,082,470	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	762,761	275,275	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
Industry	32,016	2,367,123	631,077	1,061,742	493,597	351,434	72,448
Public research institutions	182,404	71,596	82,804	253,325	255,545	62,688	23,437
Universities and colleges	4,611	135,640	75,447	751,618	47,173	75,178	33,738
Nonprofit institutions	6,210	18,253	35,848	66,598	52,400	6,942	11,078

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2005.

Research Expenditures and Number of Researchers, FY 2003

	Total spending (¥100 million)	Share funded by government (%)	Ratio of spending to GDP (%)	Number of researchers (1,000)
USA	329,004 ^a	31.0	2.61	1,261 ^b
Germany	71,060	31.1	2.51	269
Japan ^c	169,376	20.0	3.41	791 ^d
France	47,888 ^{ac}	40.8	2.16 ^{ac}	193
UK	39,458	31.3	1.88	158 ^e

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2005.

a. Provisional figure.

b. 1999.

c. 2004.

d. 2005.

e. 1998.

Nobel Prize and Fields Medal Recipients

	Nobel Prize ^a		Fields Medal 1936–2003
	Total	1946–2005	
USA	217	199	11
UK	74	48	6
Germany	65	29	3
France	26	11	8
Sweden	16	10	1
Switzerland	15	10	0
Netherlands	13	5	0
Former USSR	13	11	5
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	4
Total	510	369	44

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2005.

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

Trends in Applications for Patents by Category

	1999	2000	2001	2002	2003
Daily supply	40,681	43,998	44,539	38,166	35,583
Processing operation and transportation	70,288	72,015	69,283	62,632	59,911
Chemistry and metallurgy	43,478	44,534	43,402	34,303	29,479
Fiber and paper	4,977	4,999	5,101	4,166	3,816
Solid structure	17,861	17,581	16,230	14,308	13,281
Mechanical engineering, lighting, heating, weapons, blasting	32,557	33,750	33,406	30,858	30,305
Physics	88,696	101,933	100,624	88,143	82,603
Electricity	86,667	87,923	88,697	80,207	77,327

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 2005 totaled ¥260.3 billion, of which ¥176.5 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. However, the sixth launch in November 2003 with two information-gathering satellites resulted in failure, as it was unable to separate one of its two solid rocket boosters from the main body. In February 2005 the seventh H-IIA rocket successfully lifted off from Tanegashima Space Center in Kagoshima Prefecture and placed a multipurpose transport satellite into orbit, followed by the eighth rocket in January 2006 and the ninth in February 2006.

In an effort to encourage the commercial launch industry, the government decided in November 2002 to transfer the H-IIA project to Mitsubishi Heavy Industries, Ltd., and launches under the new regime are expected to start in fiscal 2006.

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

Budget for Space Development, 2005

(¥ million)

	Budget
Ministry of Education, Culture, Sports, Science and Technology	176,668
Cabinet Secretariat	62,411
Ministry of Internal Affairs and Communications	2,471
Ministry of Agriculture, Forestry and Fisheries	152
Ministry of Economy, Trade and Industry	3,651
Ministry of Land, Infrastructure and Transport	14,361
Ministry of the Environment	550
Total	260,264

Source: Ministry of Education, Culture, Sports, Science and Technology, *Kagaku gijutsu yoran* (Indicators of Science and Technology), 2005.

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 ¥1,201.8 billion technology trade surplus in fiscal 2004.

Patent Applications

Foreign Applications in Japan, 2004	Number	Share of total (%)
USA	22,995	42.1
Germany	7,394	13.5
Korea (ROK)	5,781	10.6
France	3,144	5.8
Netherlands	3,405	6.2
UK	1,840	3.4
Switzerland	1,799	3.3
Others	8,307	15.2
Total	54,665	100.0

Japanese Applications in Foreign Countries, 2002	Number	Share of total (%)
USA	63,470	5.1
Germany	33,055	2.6
UK	30,591	2.4
Spain	28,235	2.3
Sweden	28,207	2.3
Switzerland	28,131	2.2
Denmark	28,026	2.2
Austria	28,001	2.2
China	26,491	2.1
France	24,208	1.9
Korea (ROK)	23,656	1.9
Others	909,550	72.7
Total	1,251,621	100.0

Source: Japan Patent Office.

Japan's Technology Trade by Country and Region, FY 2004

Exports	Value (¥ billion)	Share (%)
ASIA	496.4	28.1
China	130.7	7.4
Thailand	103.3	5.8
Taiwan	72.0	4.1
Korea (ROK)	45.0	2.5
Indonesia	38.0	2.1
Malaysia	27.0	1.5
NORTH AND SOUTH AMERICA	981.8	55.5
USA	775.4	43.8
EUROPE	262.5	14.8
UK	98.4	5.6
Germany	31.9	1.8
France	31.1	1.8
Others	28.7	1.6
Total	1,769.4	100.0

Imports	Value (¥ billion)	Share (%)
NORTH AMERICA	411.7	72.5
USA	409.8	72.2
EUROPE	140.2	24.7
France	44.0	7.8
UK	24.1	4.2
Germany	22.8	4.0
Netherlands	15.0	2.6
Switzerland	9.8	1.7
Others	15.7	2.8
Total	567.6	100.0

Source: Ministry of Internal Affairs and Communications, *Kagaku gijutsu kenkyu chosa* (Survey on Research and Development), 2005.