Notes

- This booklet is published biannually. Please note that figures may vary according to the exact time of the survey.
- The figures included in this booklet are based on survey and analysis of statistics as of December 2016.
 - OECD regularly publishes R&D statistics comparing various countries, and international comparisons in this booklet are mostly based on the latest version of their biannual publication, Main Science & Technology Indicators 2016–1.
- The source of each indicator is stated in detail (in some cases with URL). The sum of individual figures and the total may not be identical due to issues such as significant figures.
 - For example, figures were rounded to the nearest integer when recomputing statistics or adjusting units (thousand KRW → 100 million KRW). Differences between the sum of individual figures and the total may arise from these processes.
- Some figures were recalculated from original data by the publishers to suit the purpose of the indicator. Thus some figures of the final year may not have been calculated.
 - For example, although GDP data for 2015 is available, R&D investment as a percentage of GDP was calculated only up to 2014 for certain countries where 2015 figures are unknown.
- Rankings were based on data of the most recent year obtained (or recomputed).



Main Science & Technology Indicators of Korea

Volume 2016-2

Ministry of Science, ICT and Future Planning



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Main Science and Technology Indicators

1. R&D Expenditure and Personnel

	Korea ('15)	USA ('13)	Japan ('14)	Germany ('14)	France ('14)	UK ('14)	China ('14)
Gross Domestic Expenditure on R&D (100 million USD)	583 (6 th)	4,570 (1 st)	1,649 (3 rd)	1,120 (4 th)	638 (5 th)	508 (7 th)	2,119 (2 nd)
- Ratio	1.00	7.84	2.83	1.92	1.09	0.87	3.63
- As a percentage of GDP (%)	4.23	2.74	3.59	2.90	2.26	1.70	2.05
 Government · Public: Private · Foreign Ratio (%) 	25:75	35:65	22:78	29:71	37:63 ('13)	35:65	20:76
Government Expenditure on R&D (100 million USD)	167	1,372 ('15)	287 ('15)	287 ('15)	157 ('15)	167	_
- As a percentage of GDP (%)	1.21	0.76 ('15)	0.70 ('15)	0.86 ('15)	0.65 ('15)	0.56	_
Total Researchers (1,000 FTE)	356 (5 th)	1,308 (2 nd)	683 (3 rd)	-	269 (8 th)	274 (7 th)	1,524 (1 st)
Total Researchers per 1,000 labor force (FTE)	13.2 (4 th)	8.3 (17 th)	10.4 (10 th)	-	9.4 (13 th)	8.4 (16 th)	1.9 (36 th)

► The sum of Government · Public: Private · Foreign Ratio in China is less than 100.0%.

 Germany was excluded since the numbers of total R&D personnel (FTE) are different in R&D Statistics, MSTI 2016–1, OECD.

► Total R&D expenditure in Korea: 65.9 trillion KRW ('15), Government Expenditure on R&D: 18.9 trillion KRW ('15)

2. R&D Performance

		Korea	USA	Japan	Germany	France	UK	China
Publications ('15)	SCI Papers	57,626 (12 th)	399,729 (1 st)	76,847 (5 th)	107,348 (4 th)	73,766 (6 th)	116,633 (3 rd)	285,642 (2 nd)
Patents	Number of triadic patent families ('13)	3,107 (4 th)	14,211 (2 nd)	16,197 (1 st)	5,525 (3 rd)	2,466 (5 th)	1,726 (7 th)	1,897 (6 th)
	Number of patent applications to the PCT ('16)	10,994 (5 th)	42,139 (1 st)	34,203 (2 nd)	13,467 (4 th)	5,602 (6 th)	4,062 (7 th)	30,658 (3 rd)
Technology balance of payments	Receipts (A, 100 million USD)	104.1	1,362.7 ('14)	345.5 ('14)	714.4 ('14)	-	456.1 ('14)	-
	Payments (B, 100 million USD)	164.1	894.2 ('14)	48.4 ('14)	543.6 ('14)	-	193.8 ('14)	-
('15)	Balance of payments ratio (A/B)	0.63	1.52 ('14)	7.13 ('14)	1.31 ('14)	-	2.35 ('14)	-
R&D-intensive industries ('15)	R&D-intensive balance of payments (100 million USD)	655.7 ('14)	- 1,391.9	- 331.0	375.7	115.7	- 225.1	1,523.4
IMD	Competitiveness ranking	29	3	26	12	32	18	25
evaluation	- Science	8	1	2	6	12	9	5
(10)	 Technology 	15	3	10	16	17	11	18

04 KOREA Main Science & Technology Indicators 2016-2

R&D Expenditure

1. Gross Domestic Expenditure on R&D (GERD)

1 GERD in Korea

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Source: MSIP · KISTEP, Survey of Research and Development in Korea

		2012	2013	2014	2015
Karaa	GERD (million USD)	49,225	54,164	60,528	58,311
Korea	As a percentage of GDP (%)	4.03	4.15	4.29	4.23
110.4	GERD (million USD)	436,078	456,977		
USA	As a percentage of GDP (%)	2.70	2.74		
Japan	GERD (million USD)	199,066	170,910	164,925	
	As a percentage of GDP (%)	3.34	3.48	3.59	
0	GERD (million USD)	101,646	105,860	112,048	
Germany	As a percentage of GDP (%)	2.87	2.83	2.90	
France	GERD (million USD)	59,771	63,042	63,826	
France	As a percentage of GDP (%)	2.23	2.24	2.26	
	GERD (million USD)	42,660	45,141	50,832	
UK	As a percentage of GDP (%)	1.62	1.66	1.70	
China	GERD (million USD)	163,147	191,205	211,862	
Unina	As a percentage of GDP (%)	1.93	2.01	2.05	

2 GERD in major countries

Source: OECD, MSTI 2016–1 (stats.oecd.org)

	2012	2013	2014	2015							
GERD per capita (1,000 KRW)	1,109.0	1,181.0	1,264.0	1,303.1							
GERD per researcher (million KRW)	138.0	144.5	145.7	145.5							

3 GERD per capita population and per researcher in Korea

Source: MSIP · KISTEP, Survey of Research and Development in Korea

GERD per capita population and per researcher (FTE) in major countries

		2012	2013	2014	2015
	Korea	984	1,079	1,200	1,152
	USA	1,387	1,442		
GERD per capita	Japan	1,561	1,342	1,297	
population	Germany	1,264	1,313	1,384	
(USD)	France	911	957	965	
	UK	670	704	787	
	China	120	141	155	
	Korea	155,977	168,292	175,210	163,591
	USA	345,216	349,378		
GERD per	Japan	307,987	258,763	241,494	
(USD)	France	230,852	236,801	236,940	
(- 3-7	UK	166,540	168,627	185,816	
	China	116,200	128,841	138,992	

► FTE (Full-time equivalent) takes into account the amount of researchers' actual participation in labor.

► Source: OECD, MSTI 2016-1 (stats.oecd.org)

MSIP · KISTEP, Survey of Research and Development in Korea

5 GERD by performance sectors in Korea

	20	2012		2013		2014		2015	
	GERD (100 million KRW)	Percentage (%)							
Business enterprises	432,229	77.9	465,599	78.5	498,545	78.2	511,364	77.5	
Higher education	52,769	9.5	54,803	9.2	57,670	9.0	59,989	9.1	
Government/ Private non-profit	69,503	12.5	72,607	12.2	81,127	12.7	88,241	13.4	
Total	554,501	100.0	593,009	100.0	637,342	100.0	637,341	100.0	

Non-profit organizations are included in government sector.

Source: MSIP · KISTEP, Survey of Research and Development in Korea

06 KOREA Main Science & Technology Indicators 2016-2



6 Percentage of GERD by performance sectors in major countries (2015)

Non-profit organizations are included in government sector.

MSIP · KISTEP, Survey of Research and Development in Korea

	2012		20	2013		2014		2015	
	GERD (100 million KRW)	Percentage (%)							
Government	138,221	24.9	142,417	24.0	152,750	24.0	162,935	24.7	
Private	414,378	74.7	448,792	75.7	480,083	75.3	491,700	74.5	
Abroad	1,902	0.3	1,800	0.3	4,508	0.7	4,959	0.8	
Total	498,904	100.0	554,501	100.0	593,009	100.0	659,594	100.0	

⑦ GERD by source of funds in Korea

Source: MSIP · KISTEP, Survey of Research and Development in Korea

8 Percentage of GERD by source of funds in major countries (%)

	Korea ('15)	USA ('13)	Japan ('14)	Germany ('14)	France ('13)	UK ('14)	China ('14)
Government	24.7	34.7	22.3	29.2	37.0	34.6	20.3
Private	74.5	60.9	77.3	65.8	55.0	46.5	75.4
Abroad	0.8	4.5	0.4	5.0	8.0	18.9	0.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	96.5

The sum of Government, Private and Abroad of China is less than 100,0%.

Source: OECD, MSTI 2016–1 (stats, oecd, org)

Source: OECD, MSTI Indicators 2016–1 (stats.oecd.org)

	2012		20	13	2014		20	2015	
	GERD (100 million KRW)	Percentage (%)							
Basic research	101,533	18.3	106,658	18.0	112,426	17.6	113,617	17.2	
Applied research	105,727	19.1	113,159	19.1	120,585	18.9	137,450	20.8	
Development research	347,242	62.6	373,193	62.9	404,330	63.4	408,528	61.9	
Total	554,501	100.0	593,009	100.0	637,341	100.0	659,594	100.0	

GERD by type of R&D in Korea

Source: MSIP · KISTEP, Survey of Research and Development in Korea

10 GERD by type of R&D in major countries (%)

	Korea ('15)	USA ('13)	Japan ('14)	France ('13)	UK ('13)	China ('14)
Basic research	17.2	17.6	12.3	24.2	15.6	4.7
Applied research	20.8	19.9	19.9	37.9	46.9	10.7
Development research	61.9	62.5	63.4	34.5	37.5	84.5

▶ For Japan and France, other sources are excluded such that the total does not add up to 100.0%.

Source: OECD, Research and Development Statistics, 2016 (stats.oecd.org) MSIP · KISTEP, Survey of Research and Development in Korea, 2015

1 GERD by future and emerging technologies (6T) in Korea

	2012		2013		2014		2015	
	GERD (100 million KRW)	Percentage (%)						
Information Technology (IT)	189,434	34.2	202,612	34.2	219,391	34.4	213,099	32.3
Biotechnology (BT)	42,459	7.7	45,043	7.6	48,097	7.5	59,946	9.1
Nanotechnology (NT)	71,193	12.8	78,193	13.2	83,587	13.1	86,609	13.1
Space Technology (ST)	7,058	1.3	7,312	1.2	7,088	1.1	13,049	2.0
Environment Technology (ET)	59,189	10.7	60,359	10.2	65,577	10.3	62,271	9.4
Culture Technology (CT)	4,525	0.8	4,346	0.7	4,917	0.8	7,027	1.1
Others	180,642	32.6	195,145	32.9	208,683	32.7	217,592	33.0
Total	554,501	100.0	593,009	100.0	637,341	100.0	659,594	100.0



12 GERD by region in Korea

--- Seoul metropolitan area 🛛 → Daejeon → Other regions

	20	12	2013		20	14	2015	
	GERD (100 million KRW)	Percentage (%)						
Seoul	99,167	17.9	107,027	18.0	96,356	15.1	100,306	15.2
Busan	10,306	1.9	9,655	1.6	11,048	1.7	12,862	1.9
Daegu	8,394	1.5	8,212	1.4	9,705	1.5	11,040	1.7
Incheon	21,319	3.8	21,328	3.6	22,829	3.6	24,996	3.8
Gwangju	6,728	1.2	5,937	1.0	6,798	1.1	7,332	1.1
Daejeon	55,709	10.0	59,401	10.0	63,330	9.9	66,551	10.1
Ulsan	7,214	1.3	7,405	1.2	8,153	1.3	9,723	1.5
Sejong			1,881	0.3	3,925	0.6	4,887	0.7
Gyeonggi	251,818	45.4	273,095	46.1	310,330	48.7	318,390	48.3
Gangwon	3,514	0.6	3,565	0.6	3,705	0.6	4,142	0.6
Chungbuk	9,548	1.7	10,598	1.8	12,539	2.0	13,797	2.1
Chungnam	25,428	4.6	26,282	4.4	23,238	3.6	22,837	3.5
Jeonbuk	7,969	1.4	8,751	1.5	8,705	1.4	8,043	1.2
Jeonnam	5,640	1.0	6,456	1.1	7,485	1.2	5,739	0.9
Gyeongbuk	21,367	3.9	21,355	3.6	26,966	4.2	26,680	4.0
Gyeongnam	19,171	3.5	20,749	3.5	20,620	3.2	20,948	3.2
Jeju	1,209	0.2	1,313	0.2	1,609	0.3	1,320	0.2
Total	554,501	100.0	593,009	100.0	637,341	100.0	659,594	100

2. Business Enterprise Expenditure on R&D (BERD)

13 Percentage of BERD financed by government in Korea (%)

	2012	2013	2014	2015
For all business enterprises	6.0	5.6	5.2	5.2
For small · medium sized businesses and start–ups	13.4	13.6	14.2	13.2

Source: MSIP · KISTEP, Survey of Research and Development in Korea (sts.ntis.go.kr)

10 Percentage of BERD financed by government in major countries (%)

	2012	2013	2014	2015
Korea	6.0	5.6	5.2	5.2
USA	10.3	9.2		
Japan	1.2	1.3	1.1	
Germany	4.6	3.6	3.6	
France	8.0	8.2		
UK	8.1	9.3	9.3	
China	4.6	4 <u>.</u> 5	4.2	

▶ Source: OECD, MSTI 2016-1 (stats.oecd.org)

MSIP · KISTEP, Survey of Research and Development in Korea

15 BERD by business type in Korea

	2012		2013		2014		2015	
	BERD (100 million KRW)	Percentage (%)						
Large Corp.	320,709	74 <u>.</u> 2	357,782	76.8	386,177	77.5	389,303	76.1
Small & medium	58,132	13.4	58,645	12.6	59,468	11.9	63,753	12.5
Start-up	53,388	12.4	49,173	10.6	52,899	10.6	58,308	11.4
Total	432,229	100.0	465,599	100.0	498,545	100.0	511,364	100.0

		2012	2013	2014	2015
	Manufacturing	379,604	412,540	443,282	458,224
BERD (100 million KRW)	Coke, refined petroleum products, chemicals and chemical products, rubber and plastic products	41,423	47,559	45,062	51,106
	Electrical machinery and apparatus, radio, TV and communications equipment	207,834	234,149	258,506	249,786
	Motor vehicles and trailers	48,935	52,764	58,763	64,729
	Services	37,771	39,382	41,172	41,174
	Manufacturing	87.8	88.6	88.9	89.6
Percentage (%)	Coke, refined petroleum products, chemicals and chemical products, rubber and plastic products	9.6	10.2	9.0	10.0
	Electrical machinery and apparatus, radio, TV and communications equipment	48.1	50.3	51.9	48.8
	Motor vehicles and trailers	11.3	11.3	11.8	12.7
	Services	8.7	8.5	8.3	8.1

106 BERD by industry in Korea

▶ Source: MSIP · KISTEP, Survey of Research and Development in Korea

17 BERD by industry in major countries (%)

	Korea ('15)	USA ('12)	Japan ('14)	Germany ('13)	France ('13)	UK ('13)
Manufacturing	89.6	69.0	86.5	86.0	50.8	39.7
Services	8.1	29.5	12.4	13.2	46.3	58.2

 Source: OECD, Research and Development Statistics, 2016 (stats, oecd, org) MSIP · KISTEP, Survey of Research and Development in Korea, 2015

198 BERD performed in R&D-intensive industries of major countries

	Korea ('14)	USA ('13)	Japan ('14)	Germany ('14)	France ('13)	UK ('13)
BERD (million USD)	26,311	146,745	41,832	17,702	14,247	11,464
Percentage (%)	55.6	45.5	32.6	23.4	34.9	39.7

 MSTI 2016-1 defines R&D-intensive industries as pharmaceutical, computer, electronic and optical, and aerospace industry.

Source: OECD, MSTI 2016–1 (stats,oecd,org)



199 BERD and its percentage relative to sales in Korea

Source: MSIP · KISTEP, Survey of Research and Development in Korea

2014) 2014 BERD of major countries as a percentage of value added in industry

	Korea	USA ('13)	Japan	Germany	France	UK	China
BERD as a percentage of value added in industry	4 <u>.</u> 87	3.06	4.33	3.09	2.54	1.75	2.03

Source: OECD, MSTI 2016–1 (stats.oecd.org)

21 BERD intensity in Korea (%)

	2012	2013	2014	2015
Top 5 companies	41.0	45.2	46.2	43.6
Top 10 companies	46.3	50.6	52.1	50.2
Top 20 companies	52.5	55.5	57.1	55.1

▶ BERD intensity is the sum of BERD of top firms (in terms of BERD size) as a percentage of the total BERD.

Rank	Name	Country	Rank	Name	Country
1	VOLKSWAGEN	Germany	26	SIEMENS	Germany
2	SAMSUNG ELECTRONICS	Korea	27	IBM	USA
3	INTEL	USA	28	BAYER	Germany
4	ALPHABET	USA	29	FACEBOOK	USA
5	MICROSOFT	USA	30	GLAXOSMITHKLINE	UK
6	NOVARTIS	Switzerland	31	FIAT CHRYSLER AUTOMOBILES	Italy
7	ROCHE	Switzerland	32	NISSAN MOTOR	Japan
8	HUAWEI INVESTMENT & HOLDING CO	China	33	ABBVIE	USA
9	JOHNSON & JOHNSON	USA	34	GENERAL ELECTRIC	USA
10	TOYOTA MOTOR	Japan	35	ERICSSON	Sweden
11	APPLE	USA	36	ELI ULLY	USA
12	PFIZER	USA	37	AMGEN	USA
13	GENERAL MOTORS	USA	38	AIRBUS	Netherlands
14	DAIMLER	Germany	39	SONY	Japan
15	MERCK	USA	40	PANASONIC	Japan
16	FORD MOTOR	USA	41	CELGENE	USA
17	CISCO SYSTEMS	USA	42	HP	USA
18	HONDA MOTOR	Japan	43	DENSO	Japan
19	ORACLE	USA	44	BOEHRINGER SOHN	Germany
20	BRISTOL-MYERS SQUIBB	USA	45	BOEING	USA
21	SANOFI	France	46	GILEAD SCIENCES	USA
22	ASTRAZENECA	UK	47	TOSHIBA	Japan
23	ROBERT BOSCH	Germany	48	LG ELECTRONICS	Korea
24	BMW	Germany	49	SAP	Germany
25	QUALCOMM	USA	50	TAKEDA PHARMACEUTICAL	Japan

22 World's top 50 companies by BERD (2015)

Source: EU, The 2015 EU Industrial R&D Investment Scoreboard (iri,jrc,ec,europa,eu/scoreboard,html)

3. Government Intramural Expenditure on R&D (GOVERD)

23 Total Government Budget Appropriations or Outlays for R&D (GBAORD) in Korea



				, ,
	2012	2013	2014	2015
General account	116,336	123,417	130,494	138,872
Special account	24,882	26,627	28,346	29,968
Funds	19,026	18,733	18,953	20,060
Supplementary budget		2,694		
Total GBAORD	160,244	168,777	177,793	188,900

(100 million KRW)

▶ Source: MSIP · KISTEP, Governmental R&D Survey and Analysis

24 Total GBAORD in major countries (2015)

	Korea	USA	Japan	Germany	France	UK ('14)
Total GBAORD (million USD)	16,700	137,172	28,730	28,727	15,719	16,747
As a percentage of GDP	1.21	0.76	0.70	0.86	0.65	0.56

▶ Source: OECD, MSTI 2016-1 (stats.oecd.org)

MSIP · KISTEP, Governmental R&D Survey and Analysis in 2015

14 KOREA Main Science & Technology Indicators 2016-2

25 GOVERD in Korea

	2012	2013	2014	2015
GOVERD (100 million KRW)	159,064	169,139	176,395	188,747
Number of projects	49,948	50,865	53,493	54,433

Source: MSIP · KISTEP, Governmental R&D Survey and Analysis

26 GOVERD by performance sectors in Korea

	20	2012		2013		2014		2015	
	GOVERD (100 million KRW)	Percentage (%)							
Research institutes	71,987	45.3	78,121	46.2	83,754	47.5	87,814	46.5	
Universities	37,214	23.4	39,718	23.5	41,023	23.3	42,617	22 <u>.</u> 6	
Business enterprises	35,353	22 <u>.</u> 2	37,143	22.0	36,510	20.7	40,310	21.4	
Ministries	4,280	2.7	4,477	2.6	4,473	2.5	6,181	3.3	
Others	10,230	6.4	9,681	5.7	10,635	6.0	11,825	6.3	
Total	159,064	100.0	169,139	100.0	176,395	100.0	188,747	100.0	

Source: MSIP · KISTEP, Governmental R&D Survey and Analysis

7 GOVERD by type of R&D in Korea

	20	2012		2013		2014		2015	
	GOVERD (100 million KRW)	Percentage (%)							
Basic research	37,432	33.8	40,450	34.1	44,528	36.3	50,303	38.4	
Applied research	24,770	22.4	26,220	22.1	27,357	22.3	26,785	20.4	
Development research	48,492	43.8	51,911	43.8	50,921	41.5	54,004	41.2	
Total	110,694	100.0	118,581	100.0	122,807	100.0	131,092	100.0	

Calculated according to the Manual for Counting Basic Research Portion of the Government R&D Budget

▶ Percentages were calculated excluding instances where categorization was difficult (ex, research equipment and facilities).

Source: MSIP · KISTEP, Governmental R&D Survey and Analysis

28 GOVERD by ministry in Korea

	20	13	20	14	20	15
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Prime Minister Office	4,784	2.8	4,868	2.8	4,616	2.4
Ministry of Agriculture, Food and Rural Affairs	1,711	1.0	1,832	1.0	2,014	1.1
Ministry of Culture, Sports and Tourism	584	0.3	660	0.4	772	0.4
Ministry of Education	15,532	9.2	15,987	9.1	16,494	8.7
Ministry of Environment	2,629	1.6	2,929	1.7	3,203	1.7
Ministry of Health and Welfare	4,214	2.5	4,508	2.6	5,042	2.7
Ministry of Science, ICT and Future Planning	55,457	32.8	60,467	34.3	64,696	34.3
Ministry of Land, Infrastructure and Transport	3,969	2.3	4,107	2.3	4,421	2.3
Ministry of National Defense	293	0.2	299	0.2	353	0.2
Ministry of Oceans and Fisheries	5,124	3.0	5,424	3.1	5,780	3.1
Ministry of Trade, Industry and Energy	31,246	18.5	31,900	18.1	34,348	18.2
Ministry of Food and Drug Safety	627	0.4	737	0.4	814	0.4
Nuclear Safety and Security Commission	675	0.4	732	0.4	703	0.4
Cultural Heritage Administration	361	0.2	340	0.2	350	0.2
Defense Acquisition Program Administration	24,481	14.5	22,830	12.9	24,525	13.0
Korea Forest Service	904	0.5	934	0.5	1,066	0.6
Korea Meteorological Administration	944	0.6	1,248	0.7	1,454	0.8
Rural Development Administration	5,525	3.3	5,836	3.3	6,046	3.2
Small and Medium Businesses Administration	8,587	5.1	8,847	5.0	9,894	5.2
Government-wide	897	0.5	860	0.5	877	0.5
Others	597	0.4	1,049	0.6	1,279	0.7
Total	169,139	100.0	176,395	100.0	188,747	100.0

Source: MSIP · KISTEP, Governmental R&D Survey and Analysis

10 GOVERD by future and emerging technologies (6T) in Korea

	20	2012		13	2014		2015	
	GOVERD (100 million KRW)	Percentage (%)						
Information Technology (IT)	28,856	19.7	29,742	19.0	30,041	18.4	33,368	19.0
Biotechnology (BT)	27,509	18.7	28,770	18.4	29,730	18.2	33,019	18.8
Nanotechnology (NT)	6,436	4.4	6,744	4.3	7,362	4.5	7,965	4.5
Space Technology (ST)	6,553	4.5	7,354	4.7	7,744	4.7	10,605	6.1
Environment Technology (ET)	23,455	16.0	24,163	15.5	24,577	15.1	23,928	13.7
Culture Technology (CT)	1,411	1.0	1,498	1.0	1,542	0.9	1,758	1.0
Others	52,576	35.8	57,932	37.1	62,151	38.1	64,557	36.8
Total	146,795	100.0	156,204	100.0	163,147	100	175,199	100.0

Subjects: Science and technology related and national defense R&D programs

Source: MSIP · KISTEP, Governmental R&D Survey and Analysis

16 KOREA Main Science & Technology Indicators **2016–2**



30 GOVERD by region in Korea

	20	12	20	13	20	14	20	15
	GOVERD (100 million KRW)	Percentage (%)						
Seoul	37,481	24.7	38,577	23.8	38,053	22.6	36,485	20.1
Busan	5,158	3.4	5,172	3.2	5,706	3.4	6,078	3.3
Daegu	3,913	2.6	4,709	2.9	5,225	3.1	5,465	3.0
Incheon	3,548	2.3	4,014	2.5	4,162	2.5	4,174	2.3
Gwangju	3,618	2.4	3,725	2.3	4,147	2.5	4,560	2.5
Daejeon	44,052	29.0	47,122	29.1	49,823	29.5	54,584	30.0
Ulsan	1,641	1.1	1,862	1.2	2,328	1.4	2,808	1.5
Sejong			93	0.1	2,182	1.3	3,682	2.0
Gyeonggi	23,605	15.5	26,003	16.1	25,530	15.1	26,112	14.4
Gangwon	1,910	1.3	2,052	1.3	2,357	1.4	2,673	1.5
Chungbuk	3,386	2.2	3,818	2.4	4,166	2.5	4,820	2.7
Chungnam	4,669	3.1	4,665	2.9	4,007	2.4	4,662	2.6
Jeonbuk	2,970	2.0	3,117	1.9	3,436	2.0	5,154	2.8
Jeonnam	1,585	1.0	1,863	1.2	2,248	1.3	3,005	1.7
Gyeongbuk	6,229	4.1	6,448	4.0	7,028	4.2	7,006	3.9
Gyeongnam	7,388	4.9	7,820	4.8	7,156	4.2	9,403	5.2
Jeju	827	0.5	833	0.5	1,098	0.7	1,136	0.6
Total	151,980	100.0	161,893	100.0	168,649	100.0	181,807	100.0

Subject: National R&D programs classified by region (except overseas and others).

▶ Source: MSIP · KISTEP, Governmental R&D Survey and Analysis



4. R&D Personnel

31 Total researchers and total R&D personnel in Korea



Source: MSIP · KISTEP, Survey of Research and Development in Korea

32 Total researchers and total R&D personnel in major countries (FTE)

		2012	2013	2014	2015
	Korea	315,589	321,842	345,463	356,447
Total	USA	1,263,204	1,307,973		
	Japan	646,347	660,489	682,935	
(FTE)	France	258,913	266,222	269,377	
(112)	UK	256,156	267,699	273,560	
	China	1,404,017	1,484,040	1,524,280	
	Korea	395,990	401,444	430,868	442,027
Total R&D	Japan	851,132	865,523	895,285	
personnel (FTE)	France	411,780	418,141	422,452	
	UK	356,484	377,343	387,934	
	China	3,246,840	3,532,817	3,710,580	

▶ Source: OECD, MSTI 2016-1 (stats.oecd.org)

33 Total researchers per 10,000 population, per 1,000 total employment and per 1,000 labor force (FTE) in Korea

Total researchers (FTE)	315,589	321,842	345,463	356,447
Total researchers per 10,000 population (FTE)	63.1	64.1	68.5	70.4
Total researchers per 1,000 total employment (FTE)	12.8	12.8	13.5	13.7
Total researchers per 1,000 labor force (FTE)	12.4	12.4	13.0	13.2

Source: MSIP · KISTEP, Survey of Research and Development in Korea

Total researchers per 10,000 population, per 1,000 total employment and per 1,000 labor force (FTE) in major countries

	Korea ('15)	USA ('13)	Japan ('14)	Germany ('14)	France ('14)	UK ('14)	China ('14)
Researchers per 10,000 population (FTE)	70.4	41.3	53.7	43.4	40.7	42.3	11.1
Researchers per 1,000 total employment (FTE)	13.7	8.9	10.5	8.2	9.9	8.9	2.0
Researchers per 1,000 labor force (FTE)	13.2	8.3	10.4	8.4	9.4	8.4	1.9

► Source: OECD, MSTI 2016-1 (stats.oecd.org)

MSIP · KISTEP, Survey of Research and Development in Korea

35 Researchers by sector of employment in Korea

	20		20	2013		2014		2015	
Business enterprises	275,986	68.7	281,874	68.7	304,808	69.7	317,842	70.1	
Higher education	96,916	24 <u>.</u> 1	97,319	23.7	99,317	22.7	99,870	22.0	
Public research institutes	28,822	7.2	31,140	7.6	33,322	7.6	35,550	7.8	
Total	401,724	100.0	410,333	100.0	437,447	100.0	453,262	100.0	

Source: MSIP · KISTEP, Survey of Research and Development in Korea

38 Percentage of researchers by sector of employment in major countries (%)

					China ('14)
Business enterprises	79.7	74.1	60.4	38.2	62.1
Universities	11.5	20.1	27.2	57.9	18.5
Public research institutes	8.8	5.7	12.3	3.9	19.4

 Source: OECD, Research and Development Statistics, 2016 (stats.oecd.org) MSIP · KISTEP, Survey of Research and Development in Korea

37 Women researchers in Korea

Total researchers	401,724	410,333	437,447	453,262
Women researchers	70,997	74,617	80,904	85,652
Women researchers as a percentage of total researchers (%)		18.2	18.5	18.9

Source: MSIP · KISTEP, Survey of Research and Development in Korea

38 Women researchers in major countries

		Japan ('14)		
Women researchers	85,652	136,206	93,256	177,801
As a percentage of total researchers (%)	18.9	14.7	25.5	38.1

Source: OECD, MSTI 2016–1 (stats,oecd,org)

MSIP · KISTEP, Survey of Research and Development in Korea

39 Distribution of researchers by sector of employment and qualification in Korea (2015)



			20			14			
Doctor	87,642	21.8	88,988	21.7	92,155	21.1	98,578	21.7	
Master	122,948	30.6	123,106	30.0	129,409	29.6	129,264	28.5	
Bachelor	169,162	42.1	175,545	42.8	190,415	43.5	199,019	43.9	
Others	21,972	5.5	22,694	5.5	25,468	5.8	26,401	5.8	
Total	401,724	100.0	410,333	100.0	437,447	100.0	453,262	100.0	

@ Researchers by qualification in Korea

Source: MSIP · KISTEP, Survey of Research and Development in Korea

(4) Researchers by field of study in Korea

	20	2012					2015	
	Researchers	Percentage (%)	Researchers				Researchers	
Natural science	53,654	13.4	51,494	12.5	54,772	12.5	57,976	12.8
Engineering	273,839	68.2	279,388	68.1	298,436	68.2	308,230	68.0
Medicine & health	19,945	5.0	23,292	5.7	23,522	5.4	24,066	5.3
Agricultural science	9,912	2.5	10,102	2.5	10,662	2.4	11,045	2.4
Humanities	20,413	5.1	20,834	5.1	22,870	5.2	23,996	5.3
Social science	23,961	6.0	25,223	6.1	27,185	6.2	27,949	6.2
Total	401,724	100.2	410,333	100.0	437,447	100.0	453,262	100.0

Source: MSIP · KISTEP, Survey of Research and Development in Korea

@ Researchers by age in Korea

	20	2012		2013					
Age									
Under 29	69,649	17.3	69,703	17.0	71,669	16.4	71,321	15.7	
30~39	189,358	47.1	187,064	45.6	195,370	44.7	197,405	43.6	
40~49	97,589	24.3	103,894	25.3	115,279	26.4	124,813	27.5	
50~59	38,413	9.6	41,929	10.2	45,653	10.4	48,835	10.8	
Over 60	6,715	1.7	7,743	1.9	9,476	2.2	10,888	2.4	
Total	401,724	100.0	410,333	100.0	437,447	100.0	453,262	100.0	



43 Researchers by region in Korea

	20		20		20		20	
	Researchers						Researchers	
Seoul	102,239	25.5	105,045	25.6	107,474	24.6	105,714	23.3
Busan	15,564	3.9	13,335	3.2	13,632	3.1	15,544	3.4
Daegu	9,673	2.4	9,002	2.2	10,625	2.4	11,756	2.6
Incheon	14,396	3.6	15,024	3.7	15,907	3.6	17,613	3.9
Gwangju	7,128	1.8	7,182	1.8	7,885	1.8	8,254	1.8
Daejeon	28,285	7.0	29,806	7.3	32,185	7.4	34,264	7.6
Ulsan	5,505	1.4	5,600	1.4	6,678	1.5	6,987	1.5
Sejong			1,551	0.4	3,049	0.7	3,565	0.8
Gyeonggi	141,819	35.3	143,975	35.1	156,871	35.9	165,118	36.4
Gangwon	5,607	1.4	5,594	1.4	6,157	1.4	6,295	1.4
Chungbuk	11,029	2.7	10,369	2.5	11,153	2.5	11,329	2.5
Chungnam	15,548	3.9	17,243	4.2	16,472	3.8	17,572	3.9
Jeonbuk	7,787	1.9	8,157	2.0	8,549	2.0	8,732	1.9
Jeonnam	3,838	1.0	3,945	1.0	4,361	1.0	4,229	0.9
Gyeongbuk	16,057	4.0	15,618	3.8	17,330	4.0	18,002	4.0
Gyeongnam	15,348	3.8	17,355	4.2	17,579	4.0	16,740	3.7
Jeju	1,901	0.5	1,532	0.4	1,540	0.4	1,548	0.3
Total	401,724	100.0	410,333	100.0	437,447	100.0	453,262	100.0

	20	2012		2013		2014			
Large corp.	141,775	51.4	147,123	52.2	157,430	51.6	154,809	48.7	
Small & medium sized	70,024	25.4	71,984	25.5	77,596	25.5	87,166	27.4	
Start-up	64,187	23.3	62,767	22.3	69,782	22.9	75,867	23.9	
Total	275,986	100.0	281,874	100.0	304,808	100.0	317,842	100.0	

4 Researchers by company types in Korea

Source: MSIP · KISTEP, Survey of Research and Development in Korea

45 Researchers by industry in Korea

	Manufacturing	216,346	219,227	236,429	246,603
Number of researchers	Coke, refined petroleum products, chemicals and chemical products, rubber and plastic products	26,821	27,954	29,148	31,879
	Electrical machinery and apparatus, radio, TV and communications equipment	93,716	93,269	99,608	97,731
	Motor vehicles and trailers	27,582	28,261	30,842	33,305
	Services	50,270	53,219	58,187	60,462
	Manufacturing	78.4	77.8	77.6	77.6
_	Coke, refined petroleum products, chemicals and chemical products, rubber and plastic products	9.7	9.9	9.6	10.0
Percentage (%)	Electrical machinery and apparatus, radio, TV and communications equipment	34.0	33.1	32.7	30.7
	Motor vehicles and trailers	10.0	10.0	10.1	10.5
	Services	18.2	18.9	19.1	19.0

Source: MSIP · KISTEP, Survey of Research and Development in Korea

We researcher and doctoral researcher intensity of the top companies in Korea (%)

			2013		
Researchers	Top 5 companies	25.1	26.2	24.9	22.7
	Top 10 companies	28.7	29.7	28.8	27.0
	Top 20 companies	32.6	33.2	32.3	30.2
	Top 5 companies	34.6	38.2	37.1	34.3
Doctoral researchers	Top 10 companies	41.3	45.4	45.4	42.0
	Top 20 companies	47.4	51.3	51.5	47.0

Principal investigators of government R&D projects by sector, gender, and degree in Korea

		20		20		20		2015	
	Research institutes	5,228	17.4	5,355	17.0	5,370	16.2	5,612	16.3
Sector	Universities	14,892	49.6	15,537	49.3	16,765	50.4	16,983	49.2
	Business enterprises	8,552	28.5	9,155	29.1	9,575	28.8	10,315	29.9
	Others	1,281	4.3	1,420	4.5	1,485	4.5	1,553	4.5
	Government ministries	64	0.2	38	0.1	50	0.2	46	0.1
	Total	30,017	100.0	31,505	100.0	33,245	100.0	34,509	100.0
	Male	26,281	88.4	27,443	87.9	28,564	86.9	29,309	85.8
Gender	Female	3,439	11.6	3,788	12.1	4,317	13.1	4,836	14.2
	Total	29,720	100.0	31,231	100.0	32,881	100.0	34,145	100.0
	Doctor	21,473	72.3	21,949	70.3	22,930	69.7	24,194	70.9
	Master	4,271	14.4	4,559	14.6	4,791	14.6	4,929	14 <u>.</u> 4
Degree	Bachelor and under	3,976	13.4	4,723	15.1	5,160	15.7	5,022	14.7
	Total	29,720	100.0	31,231	100.0	32,881	100.0	34,145	100.0

 Analysis includes principal investigators in science and technology R&D projects (excludes R&D projects in humanities and social sciences, and classified national security R&D projects).

► For projects by sector, individuals with multiple affiliations were counted multiple times.

Source: MSIP · KISTEP, Governmental R&D Survey and Analysis

⁴⁸ Current and shortfall of S&T industry personnel in Korea

Current personnel	1,554,084	1,594,398
Shortfall of personnel	36,383	36,933
Percentage of shortfall (%)	2.3	2.3

Source: MOTIE, Survey Reports on S&T Industry Personnel

5. Nurturing Human Capital

Window and the students enrolled in bachelor's, master's and doctoral programs in Korea.

		2013	2014		
Bachelor's program	Total	1,989,744	2,008,930	1,989,440	1,949,611
	Science & engineering	694,051	706,980	705,595	693,528
	Percentage of science & engineering (%)	34.9	35.2	35.5	35.6
,	Total	227,581	225,747	225,680	223,830
Master s	Science & engineering	46,954	46,815	47,179	46,662
piogram	Percentage of science & engineering (%)	20.6	20.7	20.9	20.8
D	Total	57,494	60,972	63,195	64,435
Doctoral program	Science & engineering	24,732	27,071	28,534	29,479
	Percentage of science & engineering (%)	43.0	44.4	45.2	45.7

Science & engineering is the sum of students in natural sciences and engineering. Bachelor's curriculum is the sum of 2/3-year curriculums and 4-year curriculums, Number of enrolled students excludes students on leave, Source: MOF Statistical Yearbook of Education (kess kedi re kr)

50 Number of science and engineering graduates with master's and doctoral degrees in Korea

,	Total	82,938	82,805	81,664	81,460
Master s	Science & engineering	20,469	20,043	20,078	20,076
Percentage of science & engineering (%		24.7	24.2	24.6	24.6
Doctoral degree Perce	Total	12,625	12,931	13,077	13,882
	Science & engineering	5,414	5,523	5,614	5,978
	Percentage of science & engineering (%)	42.9	42.7	42.9	43.1

Science & engineering is the sum of students in natural sciences and engineering majors.

Source: MOF Statistical Yearbook of Education (kess kedi re kr)

In the second graduates in major countries (2008~2012)

			Japan				China
New doctorates in natural sciences and engineering as a percentage of all doctorate graduates ('08~'12)	36.2	34 <u>.</u> 5	37.5	38.7	58.9 ('07~'09)	43.7	55.3 ('09~'12)

Science & engineering is the sum of students in natural sciences and engineering majors.

► Source: OECD, Science, Technology and Industry Scoreboard 2015 (www.oecd-ilibrary.org)

52 Tertiary education graduates in natural sciences and engineering as a percentage of all graduates in major countries

Year			Japan			
2002	38.6	16.3 ('03)	25.9	30.9	28.7	27.9 ('03)
2012	31.6	15.6	23.2	31.3	27.0	22.7

► Source: OECD, Science, Technology and Industry Scoreboard 2015 (www.oecd-ilibrary.org)

R&D Performance

6. Publications

W

53 Number of papers published in SCI journals in Korea

	2012			2015
Number of papers published	49,884	52,322	55,126	57,626
World share (%)	3.63	3.60	3.69	3.78
World ranking	10	12	12	12

 World share (%) is the relative share to the total number of papers published worldwide, It is different from the relative share to the sum of the number of papers published yearly by each nation, which is greater than the total number of papers published worldwide due to papers co-authored by multiple countries.

▶ Source: KISTEP · KAIST, SCI Analysis Research (2001-2015)

Sumber of papers published in SCI journals in major countries

					2015
	Number of papers	49,884	52,322	55,126	57,626
Korea	World share (%)	3.63	3.60	3.69	3.78
	World ranking	10	12	12	12
	Number of papers	379,946	393,820	399,393	399,729
USA	World share (%)	27.63	27.13	26.77	26.22
	World ranking	1	1	1	1
	Number of papers	78,488	80,095	78,385	76,847
Japan	World share (%)	5.71	5.52	5.25	5.04
	World ranking	5	5	5	5
	Number of papers	100,614	104,503	105,259	107,348
Germany	World share (%)	7.32	7.20	7.05	7.04
	World ranking	4	4	4	4
	Number of papers	70,110	73,040	72,751	73,766
France	World share (%)	5.10	5.03	4.88	4 <u>.</u> 84
	World ranking	6	6	6	6
	Number of papers	106,102	112,580	112,371	116,633
UK	World share (%)	7.71	7.76	7.53	7.65
	World ranking	3	3	3	3
	Number of papers	188,323	222,224	256,203	285,642
China	World share (%)	13.69	15.31	17.17	18.74
	World ranking	2	2	2	2

 World share (%) is the relative share to the total number of papers published worldwide, It is different from the relative share to the sum of the number of papers published yearly by each nation, which is greater than the total number of papers published worldwide due to papers co-authored by multiple countries,

▶ Source: KISTEP · KAIST, SCI Analysis Research (2001-2015)

Solution of papers published in SCI journals per 10,000 population or per 100 researchers (FTE) in Korea

				2015
Number of papers (SCI) per 10,000 population	9.98	10.42	10.93	11.38
Number of papers (SCI) per 100 researchers (FTE)	15.81	16.26	15.96	16.17

 Source: Papers (SCI) – KISTEP · KAIST, SCI Analysis Research (2001–2015) Researchers (FTE) – MSTI 2016–1 (stats.oecd.org)

Solution of papers published in SCI journals per 10,000 population or per 100 researchers (FTE) in major countries

			Japan				China
Number of papers (SCI) per 10,000 population ('15)	11.38	12.43	6.06	13.16	11.13	17.92	1.87 ('14)
Number of papers (SCI) per 100 researchers (FTE) ('15)	16.17	30.11 ('13)	11.48 ('14)		27.01 ('14)	41.08 ('14)	16.81 ('14)

 Source: Papers (SCI) – KISTEP · KAIST, SCI Analysis Research (2001–2015) Researchers (FTE) – MSTI 2016–1 (stats, oecd, org)

57 Average citations per paper over five-year period in Korea

	2008~2012	2009~2013		2011~2015
Average citations per paper over five-year periods	4.33	4.63	4.93	5.13
World average of citations	5.30	5.40	5.49	5.53

Average citations per paper over five-year periods is the average number of cumulative citations over the five-year periods from the year of publication

► Source: KISTEP KAIST, SCI Analysis Research (2001–2015)

Average citations per paper over five-year period in major countries (2011~2015)

Korea		Japan				China
5.13	7.86	5.82	7.89	7.50	7.98	5.13

Average citations per paper over five-year periods is the average number of cumulative citations over the five-year periods from the year of publication

Source: KISTEP KAIST, SCI Analysis Research (2001-2015)

				2015
NATURE	21	15	25	21
SCIENCE	11	24	21	26
CELL	7	8	10	7
Total	39	47	56	54

9 Number of papers published in top 3 journals in Korea

▶ Only full-length papers (Articles and Reviews) were counted.

► Source: KISTEP · KAIST, SCI Analysis Research (2001-2015)

60 Number of papers published by region in Korea (2015)

			First aut	
	Number of papers	Percentage (%)	Number of Papers	Percentage (%)
Seoul	29,320	33.8	19,760	40.5
Busan	4,251	4.9	2,307	4.7
Daegu	3,352	3.9	1,792	3.7
Incheon	3,257	3.8	1,437	2.9
Gwangju	3,223	3.7	1,747	3.6
Daejeon	9,033	10.4	4,817	9.9
Ulsan	1,658	1.9	845	1.7
Sejong	351	0.4	148	0.3
Gyeonggi	12,916	14.9	6,463	13.3
Gangwon	2,868	3.3	1,298	2.7
Chungbuk	2,394	2.8	1,022	2.1
Chungnam	2,469	2.8	1,142	2.3
Jeonbuk	2,854	3.3	1,484	3.0
Jeonnam	973	1.1	410	0.8
Gyeongbuk	4,150	4.8	2,259	4.6
Gyeongnam	3,064	3.5	1,495	3.1
Jeju	659	0.8	333	0.7
Others	47	0.1	17	0.0
Total	86,839	100.0	48,776	100.0

► Source: KISTEP · KAIST, SCI Analysis Research (2001-2015)

7. Patents

6 Domestic patent applications and patent grants in Korea

		2013		
Patent applications	188,915	204,589	210,292	213,694
Patent grants	113,467	127,330	129,786	101,873

Source: KIPO (kipo.go.kr)

62 Domestic patent applications and patent grants by region in Korea

			plications		Patent grants			
	2012	2013						
Seoul	44,439	47,737	48,969	48,030	25,150	29,369	28,315	22,305
Busan	4,459	4,738	5,337	5,786	2,523	2,850	2,790	2,281
Daegu	3,835	4,054	4,470	4,864	2,247	2,641	2,701	2,043
Incheon	6,150	6,185	6,438	6,633	4,135	4,478	4,351	3,214
Gwangju	2,387	2,436	2,612	3,074	1,427	1,589	1,626	1,298
Daejeon	11,190	11,197	11,118	11,283	6,569	7,809	7,550	5,238
Ulsan	3,215	3,072	2,825	2,553	1,013	1,149	1,284	911
Sejong	219	267	326	462	131	175	179	198
Gyeonggi	44,130	50,234	50,468	52,542	24,761	26,558	28,275	22,750
Gangwon	1,881	2,186	2,441	2,571	1,162	1,315	1,381	1,090
Chungbuk	2,919	2,776	3,226	3,440	1,774	1,718	1,854	1,431
Chungnam	5,192	6,020	6,473	6,309	2,800	3,379	3,598	2,996
Jeonbuk	3,536	3,789	3,501	4,007	1,405	1,615	1,777	1,338
Jeonnam	1,824	2,026	2,533	2,660	1,125	1,177	1,445	1,079
Gyeongbuk	7,314	7,634	7,235	6,858	4,216	5,946	5,723	4,491
Gyeongnam	4,935	5,017	5,502	5,548	2,963	3,076	3,465	2,840
Jeju	497	582	574	630	279	323	413	290
Others	14	28	25	23	381	500	567	525
Total	148,136	159,978	164,073	167,273	84,061	95,667	97,294	76,318

Refers to the first applicant's address

• Others' include those who are Korean citizens but do not have an address in Korea (overseas residents, soldiers, etc.).

▶ Refers to the first patent holder's address

Source: KIPO (kipo.go.kr)

63 Number of triadic patent families in Korea

	2010			2013
Triadic patent families	2,459	2,665	2,866	3,107
Triadic patent families per million population	49.8	53.5	57.3	61.9
Triadic patent families per 10,000 researchers (FTE)	93.1	92.2	90.8	96.5

▶ Triadic patent families: Patents applied to EPO and JPO, and granted by USPTO

Source: OECD, MSTI 2016–1 (stats.oecd.org)

60 Number of triadic patent families in major countries (2013)

			Japan				China
Triadic patent families	3,107	14,211	16,197	5,525	2,466	1,726	1,897
Triadic patent families per million population	61.9	44 <u>.</u> 9	127.2	68.5	37.4	26.9	1.4
Triadic patent families per 10,000 researchers (FTE)	96.5	108.7	245.2	155.9	92.6	64 <u>.</u> 5	12.8

► Source: OECD, MSTI 2016-1 (stats,oecd,org)

65 Number of patent applications to and grants from the USPTO in Korea

	2012			2015
Patent applications	29,481	33,499	36,744	38,205
Patent grants	13,233	14,548	16,469	17,924

▶ The number of patent applications: Utility Patents by their filing year

Source: USPTO (uspto.gov)

Wumber of patent applications to and grants from the USPTO in major countries (2015)

Patent applications	38,205	288,335	86,359	30,016	12,327	13,296	21,386
Patent grants	17,924	140,969	52,409	16,549	6,565	6,417	8,116

▶ The number of patent applications: Utility Patents by their filing year

▶ Country: Nationality of the first patentee. Hong Kong and Macao are not included in China.

Source: USPTO (uspto.gov)

				2015
Rank	Number of patents	Company		Company
1	7,481	INTERNATIONAL BUSINESS MACHINES CORPORATION	7,309	INTERNATIONAL BUSINESS MACHINES CORPORATION
2	4,936	SAMSUNG ELECTRONICS CO., LTD.	5,059	SAMSUNG ELECTRONICS CO., LTD.
3	4,048	CANON KABUSHIKI KAISHA	4,127	CANON KABUSHIKI KAISHA
4	3,214	SONY CORPORATION	2,900	QUALCOMM, INC.
5	2,829	MICROSOFT CORPORATION	2,835	GOOGLE, INC.
6	2,586	QUALCOMM, INC.	2,582	TOSHIBA CORPORATION
7	2,566	GOOGLE, INC.	2,448	SONY CORPORATION
8	2,537	TOSHIBA CORPORATION	2,241	LG ELECTRONICS INC.
9	2,119	LG ELECTRONICS INC.	2,046	INTEL CORPORATION
10	2,079	Panasonic Corporation	1,955	MICROSOFT CORPORATION

67 Top 10 companies granted U.S. Patents

► Source: USPTO (uspto.gov)

68 Number of patent applications to and grants from the EPO in Korea

	2012			2015
Patent applications	5,721	6,333	6,166	6,411
Patent grants	1,785	1,989	1,891	1,987

Source: EPO, Annual Report (epo.org)

In Number of patent applications to and grants from the EPO in major countries (2015)

							China
Patent applications	6,411	42,692	21,426	24,820	10,781	5,037	5,721
Patent grants	1,987	14,950	10,585	14,122	5,433	2,097	1,407

► Source: EPO, Annual Report (epo.org)

7 Number of patent applications filed under the PCT in Korea

2013			
12,381	13,119	14,564	10,994

 PCT (Patent Cooperation Treaty): International patent law treaty that provides a unified procedure for filing patent applications to protect inventions in each of its contracting states,

Source: WIPO, WIPO Statistics Database, 2016.12 (ipstats.wipo.int)

			Japan				China
PCT	10,994	42,139	34,203	13,467	5,602	4,062	30,658
Rank	5	1	2	4	6	7	3

1 Number of patent applications filed under the PCT in major countries (2016)

Source: WIPO, WIPO Statistics Database, 2016,12 (ipstats,wipo,int)

Number of patent applications filed under the PCT in the ICT and biotechnology sector in major countries (2013)

			Japan				China
ICT	5,457	22,655	16,619	4,149	2,191	2,086	13,792
Biotechnology	488	4,564	1,212	580	475	417	503

The number of patent applications by priority year

Source: OECD, MSTI 2016–1 (stats.oecd.org)

8. Technology Trade



73 Technology balance of payments in Korea

	2012	2013	2014	2015
Receipts (million USD)	5,311	6,846	9,765	10,408
Payments (million USD)	11,052	12,038	15,540	16,409
Balance of payments (million USD)	- 5,741	- 5,193	- 5,776	- 6,001
Balance of payments ratio (Receipts/Payments)	0.48	0.57	0.63	0.63

Source: MSIP · Korea Industrial Technology Association, Statistics Report on the Technology Trade of Korea

78 Technology balance of payments in major countries

	Korea ('15)	USA ('14)	Japan ('14)	Germany ('14)	UK ('14)
Receipts (million USD)	10,408	136,271	34,549	71,437	45,607
Payments (million USD)	16,409	89,415	4,843	54,364	19,377
Balance of payments (million USD)	- 6,001	46,856	29,707	17,072	26,230
Balance of payments ratio (Receipts/Payments)	0.63	1.52	7.13	1.31	2.35

Source: OECD, MSTI 2016–1 (stats.oecd.org)

MSIP · Korea Industrial Technology Association, Statistics Report on the Technology Trade of Korea

9. International Trade in High-Tech Industries



📧 International trade in R&D-intensive industries of Korea

		2012		2014
Exports (million USD)	135,281	130,500	143,107	149,598
Imports (million USD)	77,546	74,391	76,438	84,027
Trade balance (million USD)	57,735	56,110	66,670	65,571
Trade balance ratio (Exports/Imports)	1.74	1.75	1.87	1.78

 R&D-intensive industries include pharmaceutical, computer, electronic and optical, and aerospace industries, as defined by OECD, From MSTI 2013–2, the standard industrial classification was changed from ISIC Rev.3 to ISIC Rev.4.

Source: OECD, MSTI 2016-1 (stats.oecd.org)

7 International trade in R&D-intensive industries of major countries (2015)

			Japan				China
Exports (million USD)	149,598	378,203	98,468	235,544	158,970	107,369	696,435
Imports (million USD)	84,027	517,397	131,569	197,970	147,403	129,874	544,096
Trade balance (million USD)	65,571	- 139,194	- 33,101	37,574	11,567	- 22,505	152,339
Trade balance ratio (Exports/Imports)	1.78	0.73	0.75	1.19	1.08	0.83	1.28

 R&D-intensive industries include pharmaceutical, computer, electronic and optical, and aerospace industries, as defined by OECD,

Source: OECD, MSTI 2016–1 (stats.oecd.org)



7 ICT industry trade in Korea

			2014	
Exports (million USD)	94,627	107,793	114,118	115,022
Imports (million USD)	51,938	55,044	60,932	64,946
Trade balance (million USD)	42,689	52,750	53,186	50,076
Trade balance ratio (Exports/Imports)	1.82	1.96	1.87	1.77

Source: OECD, STAN Bilateral Trade Database ISIC4 ed, 2016 (stats.oecd.org)

78 ICT industry trade in major countries (2015)

	Korea		Japan				China
Exports (million USD)	115,022	142,516	57,428	62,494	21,016	18,856	612,954
Imports (million USD)	64,946	317,261	79,750	90,794	38,663	51,318	406,157
Trade balance (million USD)	50,076	- 174,746	- 22,322	- 28,300	- 17,647	- 32,462	206,797
Trade balance ratio (Exports/Imports)	1.77	0.45	0.72	0.69	0.54	0.37	1.51

Source: OECD, STAN Bilateral Trade Database ISIC4 ed. 2016 (stats.oecd.org)

10. National Competitiveness





	2013	2014	2015	2016
Overall competitiveness	22	26	25	29
Economic performance	20	20	15	21
Government efficiency	20	26	28	26
Business efficiency	34	39	37	48
Infrastructure	19	19	21	22
- Science	7	6	6	8
- Technology	11	8	13	15

Source: IMD, The World Competitiveness Yearbook

80 Competitiveness ranking of major countries (2016, IMD)

							China
Competitiveness	29	3	26	12	32	18	25
- Science	8	1	2	6	12	9	5
– Technology	15	3	10	16	17	11	18

▶ Source: IMD, The World Competitiveness Yearbook

	2013	2014	2015	2016
Total expenditure on R&D	7	6	6	6
Total expenditure on R&D as a percentage of GDP	3	1	2	1
Total expenditure on R&D per capita	20	16	14	14
Business expenditure on R&D	6	5	5	5
Business expenditure on R&D as a percentage of GDP	2	2	2	2
Total R&D personnel nationwide	7	6	6	6
Total R&D personnel nationwide per 1,000 people	14	9	9	8
Total R&D personnel in business enterprise	6	5	5	5
Total R&D personnel in business per 1,000 people	12	8	6	4
Researcher in R&D per 1,000 people**				4
Percentage of total first university degrees in science and engineering	10	9	9	16
Scientific articles	9	9	9	9
Nobel prizes	27	27	27	28
Nobel prizes per 1,000,000 people	27	27	27	28
Number of patent applications	4	4	4	4
Number of patent applications filed per 100,000 inhabitants	3	4	3	3
Number of patents granted	4	4	4	4
Number of patents in force per 100,000 inhabitants	2	4	3	3
Value added of KTI (Knowledge-and technology-intensive) industries as a percentage of GDP**				30
Scientific research is high by international standards*	21	26	19	34
Researchers/Scientists are attracted to your country*	25	33	29	34
Laws relating to scientific research do encourage innovation*	27	30	30	34
Intellectual property rights are adequately enforced*	40	41	27	38
Knowledge transfer is highly developed between companies and universities*	27	29	22	34
Innovation capacity of firms is high in your economy*	19	28	21	33
Overall Ranking	7	6	6	8

(IMD) 80 Competitiveness ranking of Korea in scientific infrastructure

*Indicators by survey
 **New indicator, KTI (Knowledge-and-technology-intensive)
 Source: IMD, The World Competitiveness Yearbook

82	Competitiveness	ranking	of	Korea	in	technological	infrastructure	(IMD)
~								(

				2016
Investment in telecommunications**				52
Mobile broadband (3G, 4G) subscribers**				4
Monthly telephone costs per capita**				50
Communications technology*	12	15	12	12
Connectivity of people and firms is highly extensive*	12	11	11	13
Computers in use (worldwide share)	11	11	11	11
Number of computers per 1,000 people	19	16	18	18
Number of internet users per 1,000 people	15	15	16	16
Number of broadband subscribers per 1,000 inhabitants	5	5	5	20
Internet bandwidth speed**				1
Information technology skills are readily available*	20	18	20	33
Qualified engineers are available in labor market*	23	28	29	34
Technological cooperation between companies is developed*	37	39	35	42
Public and private sector ventures are supporting technological development*	17	18	21	36
Development and application of technology are supported by the legal environment*	32	34	31	51
Funding for technological development is readily available*	37	42	34	44
Technological regulation to support business development and innovation*	38	30	30	43
High-tech exports	6	6	5	5
High-tech exports as a percentage of manufactured exports	7	7	6	6
ICT as a percentage of total service exports			41	39
Cyber security is being adequately addressed by corporations*	38	58	39	45
Overall Ranking	11	8	13	15

*Indicators by survey
 **New Indicator
 Source: IMD, The World Competitiveness Yearbook

	2013~2014	2014~2015	2015~2016	2016~2017
Global competitiveness	19	25	26	26
Institutions	74	82	69	63
Infrastructure	11	14	13	10
Macroeconomic environment	9	7	5	3
Health and primary education	18	27	23	29
Higher education and training	19	23	23	25
Goods market efficiency	33	33	26	24
Labor market efficiency	78	86	83	77
Financial market development	81	80	87	80
Technological readiness	22	25	27	28
Market size	12	11	13	13
Business sophistication	24	27	26	23
R&D innovation	17	17	19	20

83 Global competitiveness of Korea

Source: WEF, The Global Competitiveness Report (www.weforum.org)

8 Global competitiveness ranking of major countries (2016~2017)

Korea						China
26	3	8	5	21	7	28

Source: WEF, The Global Competitiveness Report (www.weforum.org)

85 COmposite Science and Technology Innovation Index (COSTII) of Korea

			20	2014		2015			
	Indicator (Score)				Indicator (Score)		Indicator (Score)	Ranking	
COSTII	11.866	8	12.539	7	12.531	5	12.322	5	
Resource	1.635	10	1.818	9	1.885	6	1.956	5	
Activities	4.097	3	4.191	2	4.115	2	4 <u>.</u> 141	2	
Network	1.600	13	1.896	11	1.693	8	1.543	11	
Environment	3.180	20	2.876	23	2.908	22	2.731	23	
Performance	1.875	8	1.872	10	1.931	8	1.950	9	

▶ Source: MSIP · KISTEP, COSTII (2016)



11. Energy and Resources

86 Electricity supply and demand in Korea



Tentative values are given for 2013

Source: Statistics Korea (Korea Power Exchange)

Petroleum and LNG supply in Korea

		2012	2013	2014	2015
Dotroloum	Crude oil imports (million barrels)	947	915	928	1,026
Petroleum	Amount of crude oil imports (million USD)	106,859	99,072	93,904	54,679
LNG	Imports (1,000 tons)	36,184	39,326	36,332	31,410

▶ Source: Statistics Korea (Korea National Oil Corporation, Korea Gas Corporation, and Korea Customs)

8 Total primary energy supply per 1,000 USD of GDP in major countries (2014)

	Korea	USA	Japan	Germany	France	UK	China ('13)
Energy supply (toe)/ 1,000 USD (PPP)	0.17	0.15	0.11	0.10	0.12	0.08	0.22

PPP (Purchasing Power Parity): Exchange rate to be at par with the purchasing power of the countries' currencies
 Source: OECD, Factbook 2015–2016 (www.oecd-iilbrary.org)

Nuclear electricity as a percentage of total electricity generation in major countries (2014)

Korea	USA	Germany	France	UK	China
30.1	20.2	15.8	76.9	16.6	2.4

Source: OECD, Factbook 2015-2016 (www.oecd-ilibrary.org)

40 KOREA Main Science & Technology Indicators 2016-2

		2012	2013	2014	2015
	Petroleum/Gas	359	367	372	376
	 In progress 	201	193	182	166
Number of	* Production	80	78	74	78
overseas resource	* Exploitation	29	29	28	25
exploitation	* Exploration	92	86	80	63
programs	 Completed programs 	158	174	190	210
(cumulative)	General minerals	483	508	519	525
	 In progress 	331	343	345	334
	 Completed programs 	159	165	174	191
	Petroleum/Gas	14	14	14	16
0 11 11 1	Bituminous coal	58	56	55	53
Self-sufficient	Iron	15	22	18	15
	Bronze	11	11	11	6
(%)	Zinc	19.9	21.2	21.5	21.2
	Nickel	31.9	45.8	61.7	68.9

99 Overseas natural resource exploitation in Korea

 Self-sufficient exploitation ratio indicates the percentage of resource developed and produced by domestic companies compared to total imports,

Source: Statistics Korea (Ministry of Trade, Industry & Energy)

12. Green Growth and Technology

1,000 toe, %) Renewable energy supply in Korea (1,000 toe, %)

	2011	2012	2013	2014
Renewable energy supply	7,582.8	8,850.7	9,879 <u>.</u> 2	11,537.4
Supply percentage (%)	2.8	3.2	3.5	4.1
Solar heat	27.4	26.3	27.8	28.5
Sunlight	197.2	237.5	344.5	547.4
Bio	963.4	1,334.7	1,558.5	2,822.0
Waste	5,121.5	5,998.5	6,502.4	6,904.7
Water power	965.4	814.9	892.2	581.2
Wind power	185.5	192.7	242.4	241.8
Geothermal heat	47.8	65.3	87.0	108.5
Hydrogen/Fuel cell	63.3	82.5	122.4	199.4
Marine	11.2	98.3	102.1	103.8

Supply percentage indicates the percentage of renewable energy in primary energy.

Solar heat refers to the facilities that utilize heat energy from the sun as the source of energy, and Sunlight refers to the facilities that utilize light energy from the sun to produce electricity.

Source: Statistics Korea (New Renewable Energy Center)

0	72	Contribution	of	renewables	to	enerav	supply	in	maior	countries	(%.	2014	.)
	~	00110100000000	۰.	1011011010100	•••	00.37				00001101000	\ <i>`</i> ,		1

Korea	USA	Japan	Germany	France	UK	China ('13)
1.06	6.51	4.86	11.13	8.64	6.42	10.81

Source: OECD, Factbook 2015-2016 (www.oecd-ilibrary.org)

93 CO2 emissions in major countries (kg per PPP \$ of GDP, 2013)

Korea	USA	Japan	Germany	France	UK	China
0.36	0.31	0.27	0.21	0.13	0.18	0.62

Source: The World Bank (www.worldbank.org)

98 R&D expenditure on green technology as a percentage of GOVERD in Korea

	2011	2012	2013	2014
As a percentage of GOVERD	17.2	17.1	17.9	16.1

► Source: MSIP · Green Technology Center, Statistics Yearbook of Green Technology R&D

95 R&D budget for energy and environment as a percentage of GBAORD in major countries

	Korea ('13)	USA ('14)	Japan ('14)	Germany ('14)	France ('14)	UK ('13)
Environment	2.3	0.4	1.8	2.8	1.7	2.8
Energy	8.8	1.8	12.1	5.1	5.6	2.5
Total	11.1	2.2	13.8	8.0	7.6	5.2

Source: OECD, Science, Technology and Industry Outlook 2015 (www.oecd-ilibrary.org)

13. Space

98 Space programs as a percentage of civil GBAORD in major countries (2015)

	Korea ('14)	USA	Japan	Germany	France	UK ('14)
Civil GBAORD for space programs (million USD)	426	11,629	1,780	1,358	1,654	533
Space programs as a percentage of GBAORD (%)	2.9	17.3	6.5	4.9	11.3	3.8

Government R&D budget does not include national defence budget.

Source: OECD, MSTI 2016–1 (stats.oecd.org)

7 BERD performed in aerospace industry in major countries

	Korea ('14)	USA ('13)	Japan ('14)	Germany ('14)	France ('13)	UK ('13)
Aerospace industry R&D expenditure (million USD)	72	27,114	465	2,390	4,659	2,589
Percentage of aerospace industry R&D expenditure in business enterprise R&D expenditure (%)	0.2	8.4	0.4	3.2	11.4	9.0

► Source: OECD, MSTI 2016-1 (stats.oecd.org)

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14. Biotechnology

98 Biotechnology industry in Korea

		2011	2012	2013	2014
Industry trends (trillion KRW)	Production	6.40	7.14	7.51	7.59
	Domestic demand	5.21	5.53	5.73	5.59
	Exports	2.75	3.06	3.16	3.40
	Imports	1.56	1.43	1.39	1.40
Personnel	R&D personnel	10,656	11,302	11,579	11,815
	Production personnel	11,449	11,856	12,790	12,868
	Total	22,105	23,158	24,369	24,683

▶ R&D personnel indicates personnel for R&D in bio-industry.

Production personnel indicates personnel for production, facility and quality management in biotechnology.

Source: Statistics Korea (Ministry of Trade, Industry & Energy)

15. Economic Indicators

99 Population and GDP per capita in major countries (2015)

	Korea	USA	Japan	Germany	France	UK	China ('14)
Population (thousands)	50,629	321,643	126,786	81,589	66,301	65,097	1,367,820
GDP per capita (USD)	27,197	55,798	32,521	41,132	36,527	43,762	7,568

Source: OECD, MSTI 2016-1 (stats.oecd.org)

100 Eabor force, value added of industry, and exchange rates in major countries (2015)

	Korea	USA	Japan	Germany	France	UK	China
Labor force (thousands)	26,913	158,520	65,980	42,084	28,675	32,867	796,900 ('14)
Value added of industry (100 million USD)	9,488	113,989	26,598	21,240	13,925	17,826	83,563
Exchange rate (national currency per USD)	1,131.2	1.0	121.0	0.9	0.9	0.7	6.2

Source: OECD, MSTI 2016–1 (stats.oecd.org)



Glossary

Abbreviation	Full name
EPO	European Patent Organization
IMD	International Institute for Management Development
ISIC	International Standard Industrial Classification
JPO	Japan Patent Office
KAIST	Korea Advanced Institute of Science and Technology
KIPO	Korea Intellectual Property Office
MOE	Ministry of Education
MOTIE	Ministry of Trade, Industry & Energy
MSIP	Ministry of Science, ICT and Future Planning
MSTI	Main Science and Technology Indicators
OECD	Organization for Economic Cooperation and Development
PCT	Patent Cooperation Treaty
PPP	Purchasing Power Parity
SCI	Science Citation Index
USPTO	United States Patent and Trademark Office
WEF	World Economic Forum

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Researchers

- Jong Sun Lee jongsunn@kistep.re.kr
- Hyunjune Moon mhj12112@kistep.re.kr

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