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 2018.
  - 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 2018-1.

- 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 (ten 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, if the available data for labor force is from 2017 and researchers is from 2016, total researchers per 1,000 labor force (FTE) was calculated only up to 2016.

- Rankings were based on data of the most recent year obtained (or recomputed).

2018

Korea Institute of S&T Evaluation and Planning

100 Main Science & Technology Indicators of Korea

Volume 2018-2

Ministry of Science and ICT

KISTEP Korea Institute of S&T Evaluation and Planning

CONTENTS

I Main Science and Technology Indicators

1. R&D Expenditure and Personnel

		Korea ('17)	USA ('16)	Japan ('16)	Germany ('16)	France ('16)	UK ('16)	China ('16)
R&D Expenditure	Gross Domestic Expenditure on R&D (100 million USD)	697 (5th)	5,111 (1st)	1,554 (3rd)	1,020 (4th)	554 (6th)	448 (7th)	2,359 (2nd)
	- Ratio	1.00	7.33	2.23	1.46	0.80	0.64	3.39
	- As a percentage of GDP (%)	4.55	2.74	3.14	2.93	2.25	1.69	2.11
	- Government·Public: Private·Foreign Ratio (%)	23:77	33:67	21:79	29:71	38:62 ('15)	34:66 ('15)	20:77
	Government Expenditure on R&D (100 million USD)	173	1,514 ('17)	311 ('17)	327 ('17)	155	138	-
	- As a percentage of GDP (%)	1.13	0.78	0.64	0.89	0.63	0.52	-
R&D Personnel	Total Researchers (1,000 FTE)	383	1,380 ('15)	666	401	278 ('15)	291	1,692
	Total Researchers per 1,000 labor force (FTE)	13.9	8.7 ('15)	10.0	9.3	9.4 ('15)	8.8	2.1

- Rankings were based on the data of the most recent year obtained from OECD Main Science & Techonology Indicators 2018-1, and the year given in parentheses means the base year of data shown.
- The sum of Government·Public: Private·Foreign Ratio in China is less than 100.0%.
- Total R&D expenditure in Korea: 78.8 trillion KRW ('17), Government Budget on R&D: 19.5 trillion KRW ('17)

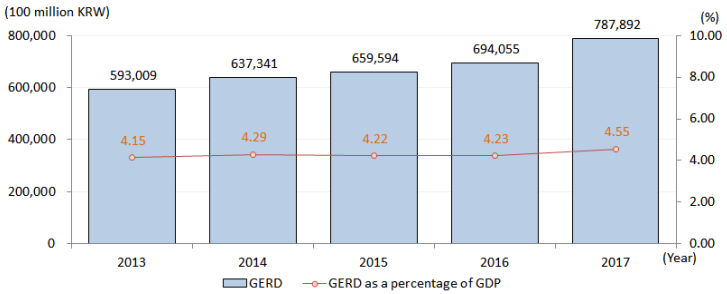
2. R&D Performance

		Korea	USA	Japan	Germany	France	UK	China
Publications ('17)	SCI Papers	60,529 (12th)	439,781 (1st)	82,797 (5th)	118,447 (4th)	79,879 (6th)	136,231 (3rd)	345,345 (2nd)
Patents	Number of triadic patent families ('16)	2,671 (5th)	15,219 (2nd)	17,066 (1st)	4,583 (3rd)	2,470 (6th)	1,740 (7th)	3,766 (4th)
	Number of patent applications to the PCT ('17)	15,752 (5th)	56,673 (1st)	48,205 (3rd)	18,950 (4th)	8,014 (6th)	5,568 (7th)	48,906 (2nd)
Technology balance of payments	Receipts (A, 100 million USD)	118.0 ('17)	1,308.3 ('15)	326.3 ('15)	718.4 ('15)	-	410.6 ('15)	-
	Payments (B, 100 million USD)	164.8 ('17)	888.9 ('15)	49.8 ('15)	537.3 ('15)	-	212.8 ('15)	-
	Balance of payments ratio (A/B)	0.72 ('17)	1.47 ('15)	6.55 ('15)	1.34 ('15)	-	1.93 ('15)	-
R&D-intensive industries ('17)	R&D-intensive balance of payments (100 million USD)	733	-1,724	-308	867	89 ('16)	-196	1,221 ('16)
IMD evaluation ('18)	Competitiveness ranking	27	1	25	15	28	20	13
	- Science	7	1	5	6	12	9	2
	- Technology	14	3	13	16	11	12	1

Ⅱ R&D Expenditure

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

① GERD in Korea



- Since the GDP for year Y is finalized on March of Y+2yrs, there is a possibility of change in GERD as a percentage of GDP that was initially extracted from November of Y+1yr.
- Source: MSIT·KISTEP, Survey of Research and Development in Korea

② GERD in major countries

		2014	2015	2016	2017
Korea	GERD (million USD)	60,528	58,311	59,810	69,699
	As a percentage of GDP (%)	4.29	4.22	4.23	4.55
USA	GERD (million USD)	476,460	496,585	511,089	
	As a percentage of GDP (%)	2.73	2.74	2.74	
Japan	GERD (million USD)	164,925	144,047	155,447	
	As a percentage of GDP (%)	3.40	3.28	3.14	
Germany	GERD (million USD)	111,773	98,465	101,958	
	As a percentage of GDP (%)	2.87	2.92	2.93	
France	GERD (million USD)	64,913	55,275	55,417	
	As a percentage of GDP (%)	2.28	2.27	2.25	
UK	GERD (million USD)	50,351	48,317	44,759	
	As a percentage of GDP (%)	1.67	1.67	1.69	
China	GERD (million USD)	211,862	227,538	235,936	
	As a percentage of GDP (%)	2.02	2.06	2.11	

- GERD is calculated by applying GERD in MSTI 2018-1 and KRW/USD currency exchange rate.
- Korea's GERD as a percentage of GDP in 2016 is changed from 4.24 to 4.23, as the result of GDP finalized on March 2018.
- Source: OECD, MSTI 2018-1 (stats.oecd.org), MSIT·KISTEP, Survey of Research and Development in Korea

3 GERD per capita population and per researcher in Korea

	2014	2015	2016	2017
GERD per capita (1,000 KRW)	1,256	1,293	1,354	1,531
GERD per researcher (million KRW)	145.7	145.5	150.6	163.2

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

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

		2014	2015	2016	2017
GERD per capita population (USD)	Korea	1,193	1,143	1,167	1,355
	USA	1,494	1,546	1,580	
	Japan	1,296	1,133	1,224	
	Germany	1,380	1,205	1,238	
	France	979	830	829	
	UK	779	742	682	
	China	155	166	171	
GERD per researcher (FTE) (USD)	Korea	175,210	163,591	165,545	181,933
	USA	352,436	359,850		
	Japan	241,494	217,571	233,556	
	Germany	317,606	253,787	254,373	
	France	238,850	199,095		
	UK	182,045	169,843	153,591	
	China	138,992	140,540	139,428	

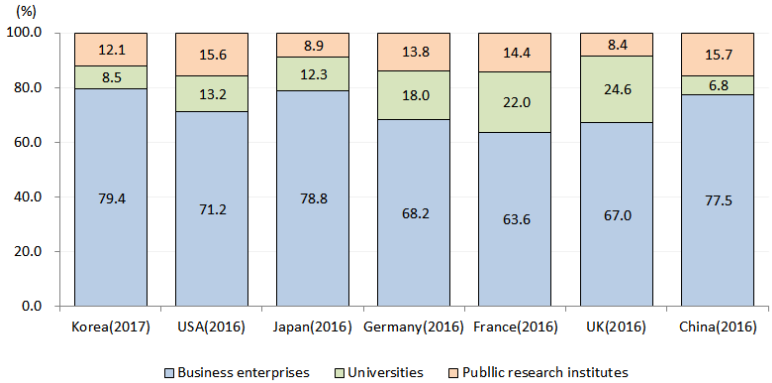
‣ FTE (Full-time equivalent) takes into account the amount of researchers' actual participation in labor.
‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)
MSIT·KISTEP, Survey of Research and Development in Korea

5 GERD by performance sectors in Korea

	2014		2015		2016		2017	
	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)
Business enterprises	498,545	78.2	511,364	77.5	539,525	77.7	625,634	79.4
Universities	57,670	9.0	59,989	9.1	63,399	9.1	66,825	8.5
Government/ Public research institutes	81,127	12.7	88,241	13.4	91,132	13.1	95,432	12.1
Total	637,341	100.0	659,594	100.0	694,055	100.0	787,892	100.0

‣ Non-profit organizations are included in government sector.
‣ Source: MSIT·KISTEP, Survey of Research and Development in Korea

6 Percentage of GERD by performance sectors in major countries



‣ Non-profit organizations are included in government sector.
‣ Source: OECD, MSTI Indicators 2018-1 (stats.oecd.org)
MSIT·KISTEP, Survey of Research and Development in Korea, 2017

7 GERD by source of funds in Korea

	2014		2015		2016		2017	
	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)
Government	152,750	24.0	162,935	24.7	164,100	23.6	177,371	22.5
Private	480,083	75.3	491,700	74.5	523,459	75.4	600,643	76.2
Abroad	4,508	0.7	4,959	0.8	6,496	0.9	9,878	1.3
Total	637,341	100.0	659,594	100.0	694,055	100.0	787,892	100.0

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

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

	Korea ('17)	USA ('16)	Japan ('16)	Germany ('16)	France ('15)	UK ('15)	China ('16)
Government	22.5	32.5	21.2	28.8	38.3	33.9	20.0
Private	76.2	62.3	78.1	65.2	54.0	49.0	76.1
Abroad	1.3	5.2	0.7	5.9	7.6	17.1	0.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	96.8

‣ The sum of Government, Private and Abroad of China is less than 100.0%.
‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)
MSIT·KISTEP, Survey of Research and Development in Korea, 2017

9 GERD by type of R&D in Korea

	2014		2015		2016		2017	
	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)
Basic research	112,426	17.6	113,617	17.2	110,867	16.0	113,911	14.5
Applied research	120,585	18.9	137,450	20.8	156,214	22.5	173,159	22.0
Development research	404,330	63.4	408,528	61.9	426,974	61.5	500,822	63.6
Total	637,341	100.0	659,594	100.0	694,055	100.0	787,892	100.0

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

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

	Korea ('17)	USA ('16)	Japan ('16)	France ('15)	UK ('15)	China ('16)
Basic research	14.5	16.9	12.6	23.8	16.7	5.2
Applied research	22.0	19.6	18.9	37.9	44.3	10.3
Development research	63.6	63.3	64.0	35.2	39.0	84.5

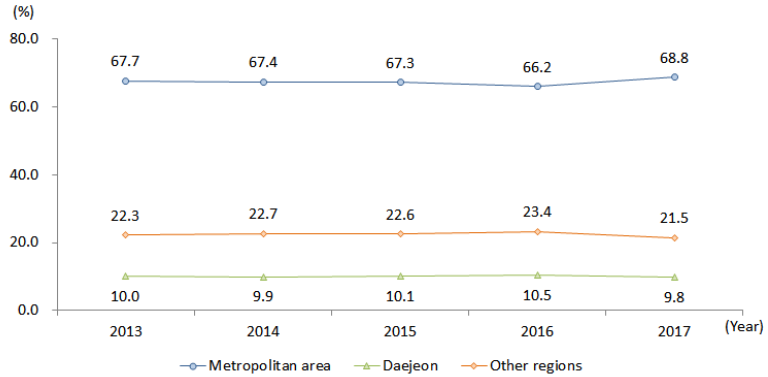
‣ For Japan and France, other sources are excluded such that the total does not add up to 100.0%.
‣ Source: OECD, Research and Development Statistics, 2018 (stats.oecd.org)
MSIT·KISTEP, Survey of Research and Development in Korea, 2017

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

	2014		2015		2016		2017	
	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)
Information Technology (IT)	219,391	34.4	213,099	32.3	234,879	33.8	287,317	36.5
Biotechnology (BT)	48,097	7.5	59,946	9.1	56,137	8.1	62,111	7.9
Nanotechnology (NT)	83,587	13.1	86,609	13.1	85,490	12.3	76,201	9.7
Space Technology (ST)	7,088	1.1	13,049	2.0	12,230	1.8	11,603	1.5
Environment Technology (ET)	65,577	10.3	62,271	9.4	62,777	9.0	70,009	8.9
Culture Technology (CT)	4,917	0.8	7,027	1.1	9,365	1.3	7,841	1.0
Others	208,683	32.7	217,592	33.0	233,169	33.6	272,810	34.6
Total	637,341	100.0	659,594	100.0	694,055	100.0	787,892	100.0

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

12 GERD by region in Korea



	2014		2015		2016		2017	
	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)	GERD (100 million KRW)	Percentage (%)
Seoul	96,356	15.1	100,306	15.2	104,839	15.1	131,697	16.7
Busan	11,048	1.7	12,862	1.9	12,417	1.8	14,033	1.8
Daegu	9,705	1.5	11,040	1.7	11,958	1.7	12,380	1.6
Incheon	22,829	3.6	24,996	3.8	23,895	3.4	25,482	3.2
Gwangju	6,798	1.1	7,332	1.1	8,353	1.2	7,933	1.0
Daejeon	63,330	9.9	66,551	10.1	72,741	10.5	76,985	9.8
Ulsan	8,153	1.3	9,723	1.5	8,015	1.2	7,299	0.9
Sejong	3,925	0.6	4,887	0.7	4,685	0.7	4,837	0.6
Gyeonggi	310,330	48.7	318,390	48.3	330,506	47.6	384,625	48.8
Gangwon	3,705	0.6	4,142	0.6	3,921	0.6	4,503	0.6
Chungbuk	12,539	2.0	13,797	2.1	21,054	3.0	22,129	2.8
Chungnam	23,238	3.6	22,837	3.5	29,801	4.3	25,614	3.3
Jeonbuk	8,705	1.4	8,043	1.2	9,003	1.3	10,322	1.3
Jeonnam	7,485	1.2	5,739	0.9	5,198	0.7	5,491	0.7
Gyeongbuk	26,966	4.2	26,680	4.0	24,177	3.5	28,468	3.6
Gyeongnam	20,620	3.2	20,948	3.2	21,937	3.2	24,537	3.1
Jeju	1,609	0.3	1,320	0.2	1,555	0.2	1,560	0.2
Total	637,341	100.0	659,594	100.0	694,055	100.0	787,892	100.0

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

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

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

	2014	2015	2016	2017
For all business enterprises	5.2	5.2	4.2	4.7
For small·medium sized businesses and start-ups	14.2	13.2	12.7	13.6

- Small·medium sized business (SME) here does not include start-ups. (SMEs is broadly accepted as the combination of SMEs and start-ups shown above.)
- Source: MSIT·KISTEP, Survey of Research and Development in Korea

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

	2014	2015	2016	2017
Korea	5.2	5.2	4.2	4.7
USA	8.0	7.8	7.0	
Japan	1.1	1.2	1.0	
Germany	3.6	3.6	3.6	
France	7.9	8.9		
UK	10.0	9.3		
China	4.2	4.3	3.7	

- Source: OECD, MSTI 2018-1 (stats.oecd.org)
  MSIT·KISTEP, Survey of Research and Development in Korea

15 BERD by business type in Korea

	2014		2015		2016		2017	
	BERD (100 million KRW)	Percentage (%)	BERD (100 million KRW)	Percentage (%)	BERD (100 million KRW)	Percentage (%)	BERD (100 million KRW)	Percentage (%)
Large Corp.	386,177	77.5	389,303	76.1	407,787	75.6	398,038	63.6
Medium							90,687	14.5
Small	59,468	11.9	63,753	12.5	68,717	12.7	70,069	11.2
Start-up	52,899	10.6	58,308	11.4	63,021	11.7	66,840	10.7
Total	498,545	100.0	511,364	100.0	539,525	100.0	625,634	100.0

- Small·medium sized business (SME) here does not include start-ups. (SMEs is broadly accepted as the combination of SMEs and start-ups shown above.)
- Careful analysis is recommended as medium sized enterprises are included in the survey since 2017
- Source: MSIT·KISTEP, Survey of Research and Development in Korea

16 BERD by industry in Korea

		2016	2017
BERD (100 million KRW)	Manufacturing	480,141	559,867
	Coke, refined petroleum products, chemicals and chemical products, rubber and plastic products	55,029	63,992
	Electrical machinery and apparatus, radio, TV and communications equipment	266,277	310,776
	Motor vehicles and trailers	65,134	78,434
	Services	46,654	52,207
Percentage (%)	Manufacturing	89.0	89.5
	Coke, refined petroleum products, chemicals and chemical products, rubber and plastic products	10.2	10.2
	Electrical machinery and apparatus, radio, TV and communications equipment	49.4	49.7
	Motor vehicles and trailers	12.1	12.5
	Services	8.6	8.3

- Careful comparison from previous data is suggested since the 10th KSIC classification standard has been applied from 2016.
- Source: MSIT·KISTEP, Survey of Research and Development in Korea

17 BERD by industry in major countries (%)

	Korea ('17)	USA ('15)	Japan ('16)	Germany ('15)	France ('13)	UK ('15)
Manufacturing	89.5	66.4	86.9	85.2	51.0	39.3
Services	8.3	31.9	11.8	14.2	46.4	57.6

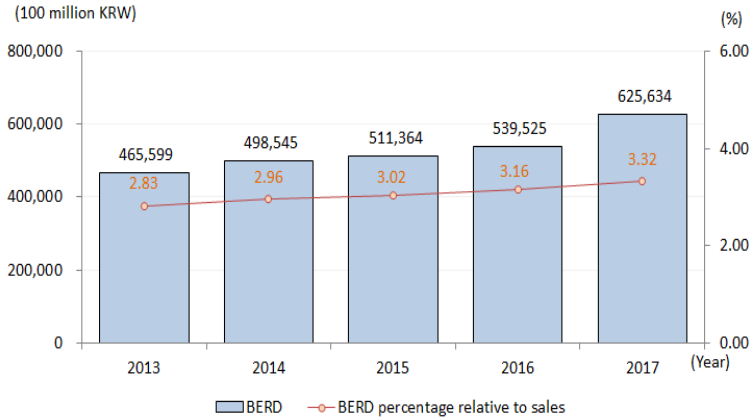
- Source: OECD, Research and Development Statistics, 2018 (stats.oecd.org)
  MSIT·KISTEP, Survey of Research and Development in Korea, 2017

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

	Korea ('15)	USA ('15)	Japan ('16)	Germany ('15)	France ('13)	UK ('15)
BERD (million USD)	24,061	158,249	37,287	14,644	14,247	4.330
Percentage (%)	53.2	44.5	30.5	21.7	34.9	13.6

- OECD defines R&D-intensive industries as pharmaceutical, computer, electronic and optical, and aerospace industry.
- Source: OECD, MSTI 2018-1 (stats.oecd.org)

19 BERD and its percentage relative to sales in Korea



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

20 BERD of major countries as a percentage of value added in industry (2016)

	Korea ('16)	USA ('16)	Japan ('16)	Germany ('16)	France ('16)	UK ('16)	China ('16)
BERD as a percentage of value added in industry	4.83	3.09	3.42	3.14	2.49	1.87	2.16

‣ Source: OECD, Main Science & Technology Indicators 2018-1 (stats.oecd.org)

21 BERD intensity in Korea (%)

	2014	2015	2016	2017
Top 5 companies	46.2	43.6	44.0	47.1
Top 10 companies	52.1	50.2	51.3	53.8
Top 20 companies	57.1	55.1	55.8	58.5

‣ BERD intensity is the sum of BERD of top firms (in terms of BERD size) as a percentage of the total BERD.
‣ Source: MSIT·KISTEP, Survey of Research and Development in Korea

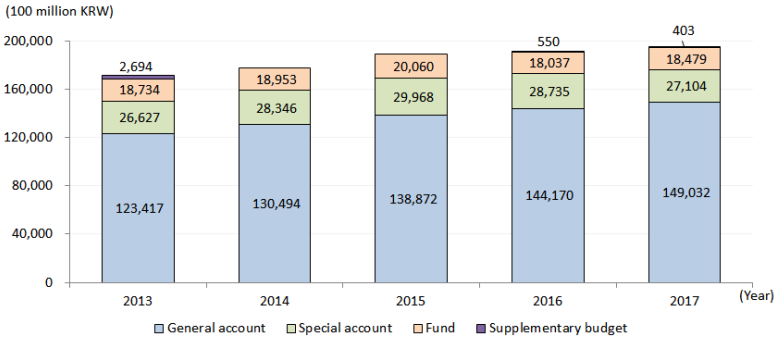
22 World's top 50 companies by BERD (2017)

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

‣ Source: EU, The 2018 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



	2014	2015	2016	2017
General account (100 million KRW)	130,494	138,872	144,170	149,032
Special account (100 million KRW)	28,346	29,968	28,735	27,104
Funds (100 million KRW)	18,953	20,060	18,037	18,479
Supplementary budget (100 million KRW)			550	403
Total GBAORD (100million KRW)	177,793	188,900	191,492	195,018

‣ Source: KISTEP, Governmental R&D Survey and Analysis

24 Total GBAORD in major countries (2017)

	Korea	USA	Japan	Germany	France ('16)	UK ('16)
Total GBAORD (million USD)	17,252	151,380	31,086	32,687	15,539	13,836
As a percentage of GDP (%)	1.13	0.78	0.64	0.89	0.63	0.52

‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)
MSIT·KISTEP, Governmental R&D Survey and Analysis, 2017

25 GOVERD in Korea

	2014	2015	2016	2017
GOVERD (100 million KRW)	176,395	188,747	190,044	193,927
Number of projects	53,493	54,433	54,827	61,280

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

26 GOVERD by performance sectors in Korea

	2014		2015		2016		2017	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Research institutes	83,754	47.5	87,814	46.5	88,188	46.4	88,853	45.8
Universities	41,023	23.3	42,617	22.6	42,727	22.5	44,052	22.7
Business enterprises	36,510	20.7	40,310	21.4	41,286	21.7	45,382	23.4
Ministries	4,473	2.5	6,181	3.3	6,281	3.3	4,692	2.4
Others	10,635	6.0	11,825	6.3	11,562	6.1	10,948	5.6
Total	176,395	100.0	188,747	100.0	190,044	100.0	193,927	100.0

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

27 GOVERD by type of R&D in Korea

	2014		2015		2016		2017	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Basic research	38,535	30.9	43,118	32.3	43,713	32.5	45,898	33.5
Applied research	25,214	20.2	25,316	19.0	25,428	18.9	26,233	19.1
Development research	60,899	48.9	65,142	48.8	65,362	48.6	65,021	47.4
Total	124,649	100.0	133,576	100.0	134,503	100.0	137,152	100.0

‣ Figures differ from those calculated according to the Manual for Counting Basic Research Portion of the Government R&D Budget, and excludes instances where categorization was difficult
‣ Source: MSIT·KISTEP, Governmental R&D Survey and Analysis

28 GOVERD by ministry in Korea

	2016		2017	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Ministry of Science and ICT	65,246	34.3	67,950	35.0
Ministry of Education	17,114	9.0	17,349	8.9
Prime Minister Office	4,656	2.4	4,554	2.3
Ministry of National Defense	409	0.2	380	0.2
Ministry of Land, Infrastructure and Transport	4,442	2.3	4,709	2.4
Korea Meteorological Administration	1,641	0.9	1,285	0.7
Ministry of Agriculture, Food and Rural Affairs	1,969	1.0	2,095	1.1
Rural Development Administration	6,222	3.3	6,366	3.3
Cultural Heritage Administration	382	0.2	403	0.2
Ministry of Culture, Sports and Tourism	821	0.4	739	0.4
Defense Acquisition Program Administration	25,011	13.2	27,376	14.1
Ministry of Health and Welfare	5,191	2.7	5,141	2.7
Korea Forest Service	1,025	0.5	1,038	0.5
Ministry of Trade, Industry and Energy	34,184	18.0	31,181	16.1
Ministry of Food and Drug Safety	817	0.4	838	0.4
Nuclear Safety and Security Commission	612	0.3	645	0.3
Ministry of SMEs and Startups	9,470	5.0	11,787	6.1
Ministry of Oceans and Fisheries	5,640	3.0	5,935	3.1
Ministry of Environment	3,005	1.6	2,875	1.5
Others	2,187	1.2	1,281	0.7
Total	190,044	100.0	193,927	100.0

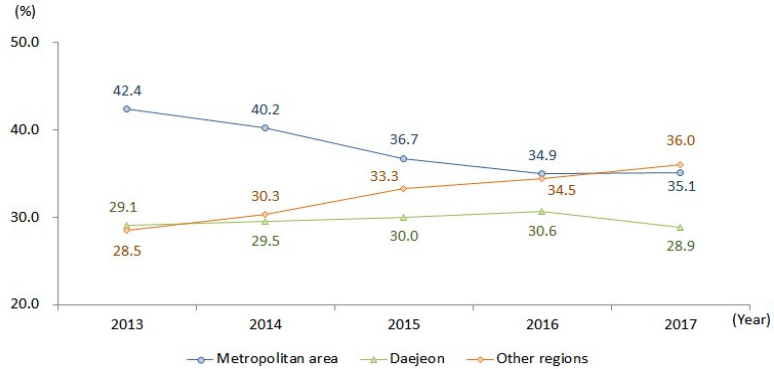
‣ Source: MSIT·KISTEP, Governmental R&D Survey and Analysis, 2017

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

	2014		2015		2016		2017	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Information Technology (IT)	30,041	18.4	33,368	19.0	33,617	19.0	33,465	18.5
Biotechnology (BT)	29,730	18.2	33,019	18.8	33,341	18.8	34,946	19.3
Nanotechnology (NT)	7,362	4.5	7,965	4.5	8,003	4.5	8,266	4.6
Space Technology (ST)	7,744	4.7	10,605	6.1	12,512	7.1	14,487	8.0
Environment Technology (ET)	24,577	15.1	23,928	13.7	22,697	12.8	22,924	12.7
Culture Technology (CT)	1,542	0.9	1,758	1.0	1,963	1.1	2,221	1.2
Others	62,151	38.1	64,557	36.8	64,871	36.6	64,521	35.7
Total	163,147	100.0	175,199	100.0	177,005	100.0	180,831	100.0

‣ Analysis on science- and technology-related R&D programs and national defense R&D programs
‣ Source: MSIT·KISTEP, Governmental R&D Survey and Analysis

30 GOVERD by region in Korea



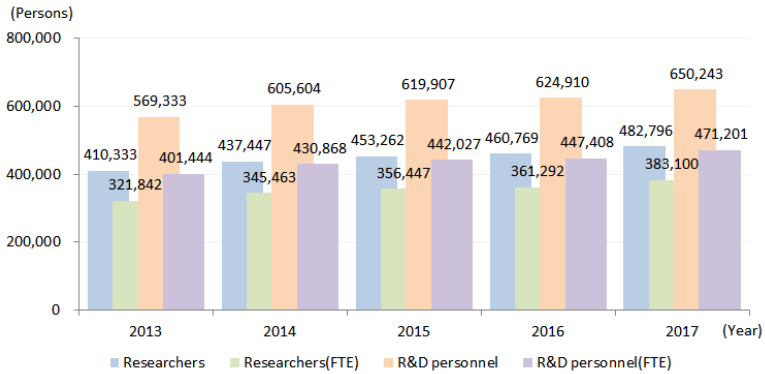
	2014		2015		2016		2017	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Seoul	38,053	22.6	36,485	20.1	35,925	19.6	37,019	19.2
Busan	5,706	3.4	6,078	3.3	6,572	3.6	7,798	4.0
Daegu	5,225	3.1	5,465	3.0	5,661	3.1	6,104	3.2
Incheon	4,162	2.5	4,174	2.3	4,385	2.4	4,281	2.2
Gwangju	4,147	2.5	4,560	2.5	4,573	2.5	4,469	2.3
Daejeon	49,823	29.5	54,584	30.0	56,115	30.6	55,630	28.9
Ulsan	2,328	1.4	2,808	1.5	2,691	1.5	2,836	1.5
Sejong	2,182	1.3	3,682	2.0	4,170	2.3	4,234	2.2
Gyeonggi	25,530	15.1	26,112	14.4	23,740	12.9	26,326	13.7
Gangwon	2,357	1.4	2,673	1.5	2,654	1.4	2,781	1.4
Chungbuk	4,166	2.5	4,820	2.7	4,962	2.7	5,446	2.8
Chungnam	4,007	2.4	4,662	2.6	4,843	2.6	4,861	2.5
Jeonbuk	3,436	2.0	5,154	2.8	6,712	3.7	7,642	4.0
Jeonnam	2,248	1.3	3,005	1.7	3,057	1.7	2,736	1.4
Gyeongbuk	7,028	4.2	7,006	3.9	6,165	3.4	6,451	3.3
Gyeongnam	7,156	4.2	9,403	5.2	9,721	5.3	12,832	6.7
Jeju	1,098	0.7	1,136	0.6	1,410	0.8	1,242	0.6
Total	168,649	100.0	181,807	100.0	183,355	100.0	192,687	100.0

‣ Subject: National R&D programs classified by region (except overseas and others).
‣ Source: MSIT·KISTEP, Governmental R&D Survey and Analysis

Ⅲ R&D Personnel

4. R&D Personnel

31 Total researchers and total R&D personnel in Korea



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

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

		2014	2015	2016	2017
Total researchers (FTE)	Korea	345,463	356,447	361,292	383,100
	USA	1,351,903	1,379,977		
	Japan	682,935	662,071	665,566	
	Germany	351,923	387,982	400,821	
	France	271,772	277,631		
	UK	276,584	284,483	291,416	
	China	1,524,280	1,619,028	1,692,176	
Total R&D personnel (FTE)	Korea	430,868	442,027	447,408	471,201
	Japan	895,285	875,005	872,340	
	Germany	605,252	640,516	656,727	
	France	423,903	428,643		
	UK	396,281	413,860	419,898	
	China	3,710,580	3,758,848	3,878,057	

‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)
MSIT·KISTEP, Survey of Research and Development in Korea

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

	2014	2015	2016	2017
Total researchers (FTE)	345,463	356,447	361,292	383,100
Total researchers per 10,000 population (FTE)	68.1	69.9	70.5	74.5
Total researchers per 1,000 total employee (FTE)	13.5	13.7	13.8	14.4
Total researchers per 1,000 labor force (FTE)	13.0	13.2	13.3	13.9

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

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

	Korea ('17)	USA ('15)	Japan ('16)	Germany ('16)	France ('15)	UK ('16)	China ('16)
Researchers per 10,000 population (FTE)	74.5	43.0	52.5	48.7	41.7	44.4	12.2
Researchers per 1,000 total employment (FTE)	14.4	9.1	10.0	9.2	10.1	9.2	2.2
Researchers per 1,000 labor force (FTE)	13.9	8.7	10.0	9.3	9.4	8.8	2.1

‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)
MSIT·KISTEP, Survey of Research and Development in Korea

35 Researchers by sector of employment in Korea

	2014		2015		2016		2017	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Business enterprises	304,808	69.7	317,842	70.1	321,323	69.7	343,367	71.1
Universities	99,317	22.7	99,870	22.0	103,166	22.4	102,877	21.3
Public research institutes	33,322	7.6	35,550	7.8	36,280	7.9	36,552	7.6
Total	437,447	100.0	453,262	100.0	460,769	100.0	482,796	100.0

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

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

	Korea ('17)	Japan ('16)	France ('15)	UK ('16)	China ('16)
Business enterprises	81.3	73.4	59.7	37.8	61.9
Universities	10.1	20.7	28.7	58.4	18.2
Public research institutes	8.5	5.8	11.6	3.8	19.9

‣ Source: OECD, Research and Development Statistics, 2018 (stats.oecd.org)
MSIT·KISTEP, Survey of Research and Development in Korea, 2017

37 Women researchers in Korea

	2014	2015	2016	2017
Total researchers	437,447	453,262	460,769	482,796
Women researchers	80,904	85,652	90,615	97,042
Women researchers as a percentage of total researchers (%)	18.5	18.9	19.7	20.1

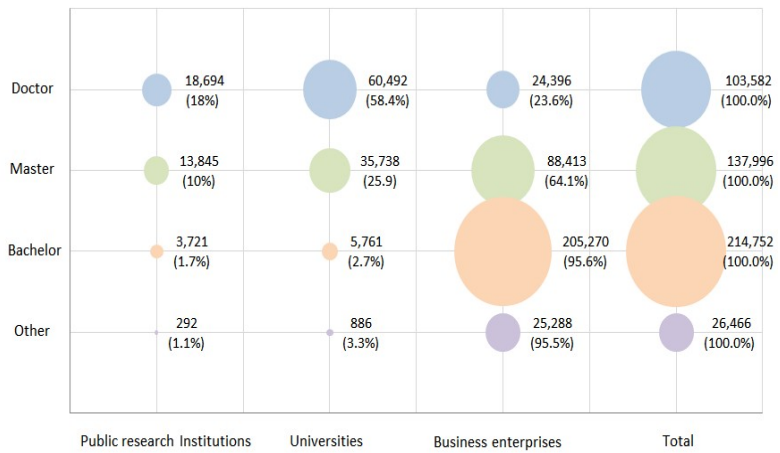
‣ Source: MSIT·KISTEP, Survey of Research and Development in Korea

38 Women researchers in major countries

	Korea ('17)	Japan ('16)	Germany ('15)	France ('15)	UK ('15)
Women researchers	97,042	144,126	164,095	103,521	191,774
As a percentage of total researchers (%)	20.1	15.7	28.0	27.0	38.6

‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)
MSIT·KISTEP, Survey of Research and Development in Korea, 2017

39 Researchers by sector of employment and qualification in Korea (2017)



‣ Source: MSIT·KISTEP, Survey of Research and Development in Korea, 2017

40 Researchers by qualification in Korea

	2014		2015		2016		2017	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Doctor	92,155	21.1	98,578	21.7	99,980	21.7	103,582	21.5
Master	129,409	29.6	129,264	28.5	132,595	28.8	137,996	28.6
Bachelor	190,415	43.5	199,019	43.9	200,189	43.4	214,752	44.5
Others	25,468	5.8	26,401	5.8	28,005	6.1	26,466	5.5
Total	437,447	100.0	453,262	100.0	460,769	100.0	482,796	100.0

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

41 Researchers by major field of study in Korea

	2014		2015		2016		2017	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Natural science	54,772	12.5	57,976	12.8	56,710	12.3	67,736	14.0
Engineering	298,436	68.2	308,230	68.0	312,987	67.9	322,952	66.9
Medicine & health	23,522	5.4	24,066	5.3	26,347	5.7	27,911	5.8
Agricultural science	10,662	2.4	11,045	2.4	11,378	2.5	10,423	2.2
Humanities	22,870	5.2	23,996	5.3	24,734	5.4	26,576	5.5
Social science	27,185	6.2	27,949	6.2	28,613	6.2	27,198	5.6
Total	437,447	100.0	453,262	100.0	460,769	100.0	482,796	100.0

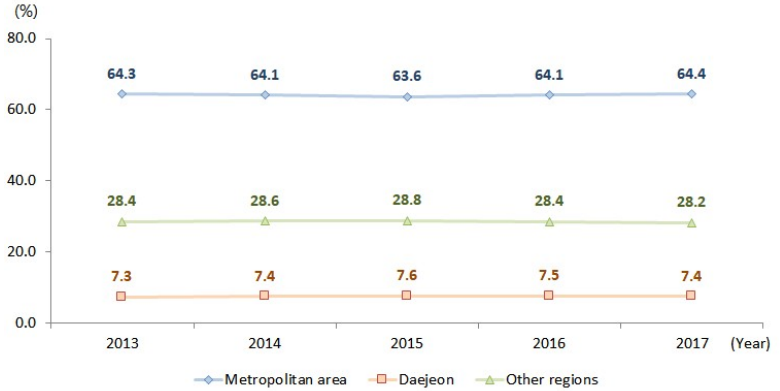
‣ Source: MSIT·KISTEP, Survey of Research and Development in Korea

42 Researchers by age in Korea

	2014		2015		2016		2017	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Under 29	71,669	16.4	71,321	15.7	71,915	15.6	73,767	15.3
30~39	195,370	44.7	197,405	43.6	197,353	42.8	201,623	41.8
40~49	115,279	26.4	124,813	27.5	128,691	27.9	139,118	28.8
50~59	45,653	10.4	48,835	10.8	50,515	11.0	54,136	11.2
Over 60	9,476	2.2	10,888	2.4	12,295	2.7	14,152	2.9
Total	437,447	100.0	453,262	100.0	460,769	100.0	482,796	100.0

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

43 Researchers by region in Korea



	2014		2015		2016		2017	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Seoul	107,474	24.6	105,714	23.3	110,080	23.9	118,541	24.6
Busan	13,632	3.1	15,544	3.4	14,683	3.2	14,371	3.0
Daegu	10,625	2.4	11,756	2.6	11,453	2.5	11,781	2.4
Incheon	15,907	3.6	17,613	3.9	18,435	4.0	19,635	4.1
Gwangju	7,885	1.8	8,254	1.8	8,485	1.8	7,722	1.6
Daejeon	32,185	7.4	34,264	7.6	34,509	7.5	35,745	7.4
Ulsan	6,678	1.5	6,987	1.5	7,372	1.6	7,807	1.6
Sejong	3,049	0.7	3,565	0.8	3,562	0.8	4,109	0.9
Gyeonggi	156,871	35.9	165,118	36.4	166,737	36.2	172,583	35.7
Gangwon	6,157	1.4	6,295	1.4	5,886	1.3	6,668	1.4
Chungbuk	11,153	2.5	11,329	2.5	11,505	2.5	12,324	2.6
Chungnam	16,472	3.8	17,572	3.9	17,362	3.8	17,139	3.5
Jeonbuk	8,549	2.0	8,732	1.9	9,172	2.0	9,126	1.9
Jeonnam	4,361	1.0	4,229	0.9	4,199	0.9	4,493	0.9
Gyeongbuk	17,330	4.0	18,002	4.0	17,873	3.9	19,335	4.0
Gyeongnam	17,579	4.0	16,740	3.7	17,722	3.8	19,584	4.1
Jeju	1,540	0.4	1,548	0.3	1,734	0.4	1,833	0.4
Total	437,447	100.0	453,262	100.0	460,769	100.0	482,796	100.0

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

44 Researchers by company types in Korea

	2014		2015		2016		2017	
	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Large corp.	157,430	51.6	154,809	48.7	155,658	48.4	115,791	33.7
Medium							54,408	15.8
Small	77,596	25.5	87,166	27.4	89,384	27.8	92,427	26.9
Start-up	69,782	22.9	75,867	23.9	76,281	23.7	80,741	23.5
Total	304,808	100.0	317,842	100.0	321,323	100.0	343,367	100.0

- Small·medium sized business (SME) here does not include start-ups. (SMEs is broadly accepted as the combination of SMEs and start-ups shown above.)
- Careful analysis is recommended as medium enterprises are included in the survey since 2017
- Source: MSIT·KISTEP, Survey of Research and Development in Korea

45 Researchers by industry in Korea

		2016	2017
Number of researchers	Manufacturing	248,169	263,045
	Coke, refined petroleum products, chemicals and chemical products, rubber and plastic products	33,497	36,424
	Electrical machinery and apparatus, radio, TV and communications equipment	93,061	95,736
	Motor vehicles and trailers	34,087	36,387
	Services	63,165	69,703
Percentage (%)	Manufacturing	77.2	76.6
	Coke, refined petroleum products, chemicals and chemical products, rubber and plastic products	10.4	10.6
	Electrical machinery and apparatus, radio, TV and communications equipment	29.0	27.9
	Motor vehicles and trailers	10.6	10.6
	Services	19.7	20.3

- Source: MSIT·KISTEP, Survey of Research and Development in Korea, 2017

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

		2014	2015	2016	2017
Researchers	Top 5 companies	24.9	22.7	22.6	21.9
	Top 10 companies	28.8	27.0	26.6	26.1
	Top 20 companies	32.3	30.2	29.8	29.3
Doctoral researchers	Top 5 companies	37.1	34.3	32.3	33.1
	Top 10 companies	45.4	42.0	39.2	39.7
	Top 20 companies	51.5	47.0	45.1	45.5

- Researcher and doctoral researcher intensities were calculated by the order of the highest from each category.
- Source: MSIT·KISTEP, Survey of Research and Development in Korea

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

		2014		2015		2016		2017	
		Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Sector	Research institutes	5,370	16.2	5,612	16.3	5,690	16.0	5,829	14.2
	Universities	16,765	50.4	16,983	49.2	17,228	48.3	20,668	50.5
	Business enterprises	9,575	28.8	10,315	29.9	11,002	30.9	12,892	31.5
	Others	1,485	4.5	1,553	4.5	1,654	4.6	1,498	3.7
	Ministries	50	0.2	46	0.1	61	0.2	61	0.1
	Total	33,245	100.0	34,509	100.0	35,635	100.0	40,948	100.0
Gender	Male	28,564	86.9	29,309	85.8	30,102	85.4	34,013	83.9
	Female	4,317	13.1	4,836	14.2	5,147	14.6	6,533	16.1
	Total	32,881	100.0	34,145	100.0	35,249	100.0	40,546	100.0
Degree	Doctor	22,930	69.7	24,194	70.9	25,102	71.2	29,284	72.2
	Master	4,791	14.6	4,929	14.4	4,936	14.0	4,711	11.6
	Bachelor and under	5,160	15.7	5,022	14.7	5,211	14.8	6,551	16.2
	Total	32,881	100.0	34,145	100.0	35,249	100.0	40,546	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: MSIT·KISTEP, Governmental R&D Survey and Analysis

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

	2015	2016
Current personnel	1,594,398	1,617,053
Shortfall of personnel	36,933	36,271
Percentage of shortfall (%)	2.3	2.2

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

5. Nurturing Human Capital

49 Number of students enrolled in bachelor's, master's and doctoral programs in Korea

		2015	2016	2017	2018
Bachelor's program	Total	1,989,440	1,949,611	1,912,012	1,904,364
	Science & engineering	705,595	693,528	686,597	691,435
	Percentage of science & engineering (%)	35.5	35.6	35.9	36.3
Master's program	Total	225,680	223,830	218,096	214,413
	Science & engineering	47,179	46,662	45,128	45,099
	Percentage of science & engineering (%)	20.9	20.8	20.7	21.0
Doctoral program	Total	63,195	64,435	64,345	64,479
	Science & engineering	28,534	29,479	29,294	29,052
	Percentage of science & engineering (%)	45.2	45.7	45.5	45.1

- 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: MOE, Statistical Yearbook of Education (kess.kedi.re.kr)

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

		2015	2016	2017	2018
Master's degree	Total	81,664	81,460	83,519	82,837
	Science & engineering	20,078	20,076	20,780	20,267
	Percentage of science & engineering (%)	24.6	24.6	24.9	24.5
Doctoral degree	Total	13,077	13,882	14,316	14,674
	Science & engineering	5,614	5,978	6,177	6,351
	Percentage of science & engineering (%)	42.9	43.1	43.1	43.3

- Science & engineering is the sum of students in natural sciences and engineering majors.
- Source: MOE, Statistical Yearbook of Education (kess.kedi.re.kr)

51 New doctorates in natural sciences and engineering as a percentage of all graduates in major countries (%, 2016)

	Korea	USA	Japan	Germany	France	UK
New doctorates in natural sciences and engineering as a percentage of all doctorate graduates	38.8	38.9	37.5	41.3	58.0	42.9

- Science & engineering is the sum of students in natural sciences and engineering majors, and natural sciences here means field 4 (science, comprising the life sciences, physical sciences, mathematics and statistics and computing) in ISCED2011.
- Source: OECD, Education at a Glance 2018 (www.oecd-ilibrary.org)

52 Tertiary education graduates in natural sciences and engineering as a percentage of all graduates in major countries (%, 2005, 2015)

Year	Korea	USA	Japan	Germany	France	UK
2005	37.8	15.7	24.8	31.3	27.1	23.8
2015	29.6	17.4	21.0	36.8	25.3	26.2

- Tertiary education graduate school indicates all forms of institutes with the purpose of official tertiary education regardless of legal status.
- Source: OECD, Science, Technology and Industry Scoreboard 2017 (www.oecd-ilibrary.org)

Ⅳ R&D Performance

6. Publications

53 Number of papers published in SCI journals in Korea

	2014	2015	2016	2017
Number of papers published	55,770	58,785	60,185	60,529
World share (%)	3.45	3.53	3.52	3.51
World ranking	12	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 (2002-2016)

54 Number of papers published in SCI journals in major countries

		2014	2015	2016	2017
Korea	Number of papers	55,770	58,785	60,185	60,529
	World share (%)	3.45	3.53	3.52	3.51
	World ranking	12	12	12	12
USA	Number of papers	432,179	435,271	443,566	439,781
	World share (%)	26.71	26.16	25.94	25.51
	World ranking	1	1	1	1
Japan	Number of papers	80,791	80,012	82,466	82,797
	World share (%)	4.99	4.81	4.82	4.80
	World ranking	5	5	5	5
Germany	Number of papers	111,001	113,684	117,750	118,447
	World share (%)	6.86	6.83	6.89	6.87
	World ranking	4	4	4	4
France	Number of papers	76,206	78,221	80,750	79,879
	World share (%)	4.71	4.70	4.72	4.63
	World ranking	6	6	6	6
UK	Number of papers	125,713	131,816	136,743	136,231
	World share (%)	7.77	7.92	8.00	7.90
	World ranking	3	3	3	3
China	Number of papers	252,120	282,464	311,330	345,345
	World share (%)	15.58	16.97	18.21	20.03
	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 (2003-2017)

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

	2014	2015	2016	2017
Number of papers (SCI) per 10,000 population	10.99	11.52	11.74	11.77
Number of papers (SCI) per 100 researchers (FTE)	16.14	16.49	16.66	15.80

‣ Source: Source: OECD, MSTI 2018-1 (stats.oecd.org)
Papers (SCI) - KISTEP·KAIST, SCI Analysis Research (2003-2017)

56 Number of papers published in SCI journals per 10,000 population or per 100 researchers (FTE) in major countries (2017)

	Korea	USA	Japan	Germany	France	UK	China
Number of papers (SCI) per 10,000 population	11.77	13.50	6.53	14.33	11.90	20.63	2.48
Number of papers (SCI) per 100 researchers (FTE)	15.80	31.54 ('15)	12.39 ('16)	29.38 ('16)	28.17 ('15)	46.92 ('16)	18.40 ('16)

‣ Source: Source: OECD, MSTI 2018-1 (stats.oecd.org)
Papers (SCI) - KISTEP·KAIST, SCI Analysis Research (2003-2017)

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

	2010~2014	2011~2015	2012~2016	2013~2017
Average citations per paper over five-year periods	5.07	5.33	5.65	5.84
World average of citations	5.29	5.40	5.57	5.71

‣ 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 (2003-2017)

58 Average citations per paper over five-year period in major countries (2013~2017)

Korea	USA	Japan	Germany	France	UK	China
5.84	7.89	6.09	8.25	7.99	8.00	6.00

‣ 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 (2003-2017)

59 Number of papers published in top 3 journals in Korea

	2014	2015	2016	2017
NATURE	24	19	23	26
SCIENCE	20	23	20	23
CELL	10	7	5	2
Total	54	49	48	51

‣ Only full-length papers (Articles and Reviews) were counted.
‣ Source: KISTEP·KAIST, SCI Analysis Research (2003-2017)

60 Number of papers published by region in Korea (2017)

	Co-authorship		First authorship	
	Number of papers	Percentage (%)	Number of Papers	Percentage (%)
Seoul	31,057	33.9	20,592	41.2
Gyeonggi	13,573	14.8	6,633	13.3
Daejeon	9,390	10.3	4,693	9.4
Busan	4,380	4.8	2,328	4.7
Gyeongbuk	4,302	4.7	2,223	4.4
Daegu	3,805	4.2	1,916	3.8
Incheon	3,555	3.9	1,579	3.2
Gwangju	3,225	3.5	1,717	3.4
Gangwon	3,150	3.4	1,345	2.7
Jeonbuk	3,115	3.4	1,450	2.9
Gyeongnam	3,025	3.3	1,448	2.9
Chungnam	2,479	2.7	1,134	2.3
Chungbuk	2,375	2.6	1,006	2.0
Ulsan	1,915	2.1	977	2.0
Jeonnam	1,030	1.1	429	0.9
Jeju	668	0.7	317	0.6
Sejong	494	0.5	225	0.4
Others	49	0.1	20	0.0
Total	91,587	100.0	50,032	100.0

‣ Source: KISTEP·KAIST, SCI Analysis Research (2003-2017)

7. Patents

61 Domestic patent applications and patent grants in Korea

	2014	2015	2016	2017
Patent applications	210,292	213,694	208,830	204,775
Patent grants	129,786	101,873	108,875	120,662

‣ Source: KIPO (kipo.go.kr)

62 Domestic patent applications and patent grants by region in Korea

	Patent applications				Patent grants			
	2014	2015	2016	2017	2014	2015	2016	2017
Seoul	48,969	48,030	47,288	45,482	28,315	22,305	25,087	27,527
Busan	5,337	5,786	5,989	6,422	2,790	2,281	2,527	3,061
Daegu	4,470	4,864	4,735	4,779	2,701	2,043	2,365	2,612
Incheon	6,438	6,633	5,989	6,195	4,351	3,214	3,307	3,400
Gwangju	2,612	3,074	3,321	3,279	1,626	1,298	1,410	1,694
Daejeon	11,118	11,283	10,811	10,734	7,550	5,238	5,492	6,503
Ulsan	2,825	2,553	2,421	736	1,284	911	1,016	307
Sejong	326	462	548	2,267	179	198	249	1,269
Gyeonggi	50,468	52,542	48,764	46,133	28,275	22,750	23,381	24,820
Gangwon	2,441	2,571	2,410	2,572	1,381	1,090	1,291	1,459
Chungbuk	3,226	3,440	3,498	3,166	1,854	1,431	1,670	1,861
Chungnam	6,473	6,309	6,578	6,046	3,598	2,996	3,008	3,492
Jeonbuk	3,501	4,007	3,993	4,121	1,777	1,338	1,468	1,860
Jeonnam	2,533	2,660	2,700	2,902	1,445	1,079	1,201	1,616
Gyeongbuk	7,235	6,858	7,048	6,764	5,723	4,491	4,594	4,633
Gyeongnam	5,502	5,548	6,625	6,609	3,465	2,840	3,538	3,738
Jeju	574	630	689	817	413	290	305	384
Others	25	23	17	7	567	525	491	611
Total	164,073	167,273	163,424	159,031	97,294	76,318	82,400	90,847

‣ Refers to the first applicant's address
‣ Refers to the first patent holder's address
‣ Source: KIPO (kipo.go.kr)

63 Number of triadic patent families in Korea

	2013	2014	2015	2016
Triadic patent families	2,547	2,678	2,670	2,671
Triadic patent families per million population	50.5	52.8	52.3	52.1
Triadic patent families per 10,000 researchers (FTE)	79.1	77.5	74.9	73.9

‣ Triadic patent families: Patents applied to EPO and JPO, and granted by USPTO
‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)

64 Number of triadic patent families in major countries (2016)

	Korea	USA	Japan	Germany	France	UK	China
Triadic patent families	2,671	15,219	17,066	4,583	2,470	1,740	3,766
Triadic patent families per million population	52.1	47.1	134.4	55.7	36.9	26.5	2.7
Triadic patent families per 10,000 researchers (FTE)	73.9	111.2 ('15)	256.4	114.3	89.1 ('15)	59.7	22.3

‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)

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

	2012	2013	2014	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)

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

	Korea	USA	Japan	Germany	France	UK	China
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)

67 Top 10 companies granted U.S. Patents

Rank	2014		2015	
	Number of patents	Company	Number of patents	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

‣ Source: USPTO (uspto.gov)

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

	2014	2015	2016	2017
Patent applications	6,166	6,407	6,821	6,261
Patent grants	1,891	1,993	3,210	4,435

‣ Source: EPO, Annual Report 2017 (epo.org)

69 Number of patent applications to and grants from the EPO in major countries (2017)

	Korea	USA	Japan	Germany	France	UK	China
Patent applications	6,261	42,300	21,712	25,490	10,559	5,313	8,330
Patent grants	4,435	24,960	17,660	18,813	7,325	3,116	3,180

‣ Source: EPO, Annual Report 2017 (epo.org)

70 Number of patent applications filed under the PCT in Korea

2014	2015	2016	2017
13,119	14,564	15,555	15,752

‣ 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, 2018.12 (ipstats.wipo.int)

71 Number of patent applications filed under the PCT in major countries (2017)

	Korea	USA	Japan	Germany	France	UK	China
PCT	15,752	56,673	48,205	18,950	8,014	5,568	48,906
Rank	5	1	3	4	6	7	2

‣ Source: WIPO, WIPO Statistics Database, 2018.12 (ipstats.wipo.int)

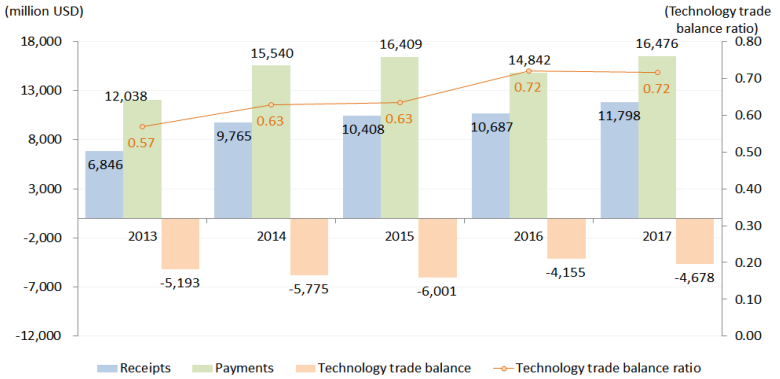
72 Number of patent applications filed under the PCT in the ICT and biotechnology sector in major countries (2016)

	Korea	USA	Japan	Germany	France	UK	China
ICT	5,571	17,400	10,776	2,608	1,349	1,373	19,958
Biotechnology	703	5,081	1,373	661	505	498	800

‣ The number of patent applications by priority year
‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)

8. Technology Trade

73 Technology balance of payments in Korea



	2014	2015	2016	2017
Receipts (million USD)	9,765	10,408	10,687	11,798
Payments (million USD)	15,540	16,409	14,842	16,476
Balance of payments (million USD)	-5,775	-6,001	-4,155	-4,678
Balance of payments ratio (Receipts/Payments)	0.63	0.63	0.72	0.72

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

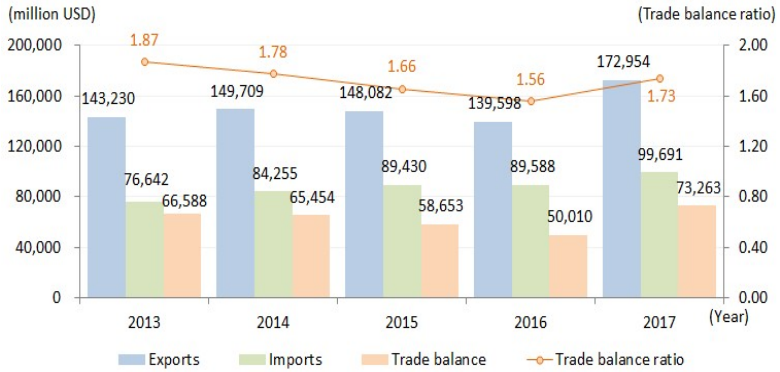
74 Technology balance of payments in major countries

	Korea ('17)	USA ('15)	Japan ('15)	Germany ('15)	UK ('15)
Receipts (million USD)	11,798	130,834	32,631	71,836	41,061
Payments (million USD)	16,476	88,891	4,979	53,734	21,280
Balance of payments (million USD)	-4,678	41,943	27,653	18,102	19,780
Balance of payments ratio (Receipts/Payments)	0.72	1.47	6.55	1.34	1.93

‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)
MSIT·Korea Industrial Technology Association, Statistics Report on the Technology Trade of Korea, 2017

9. International Trade in High-Tech Industries

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



	2014	2015	2016	2017
Exports (million USD)	149,709	148,082	139,598	172,954
Imports (million USD)	84,255	89,430	89,588	99,691
Trade balance (million USD)	65,454	58,653	50,010	73,263
Trade balance ratio (Exports/Imports)	1.78	1.66	1.56	1.73

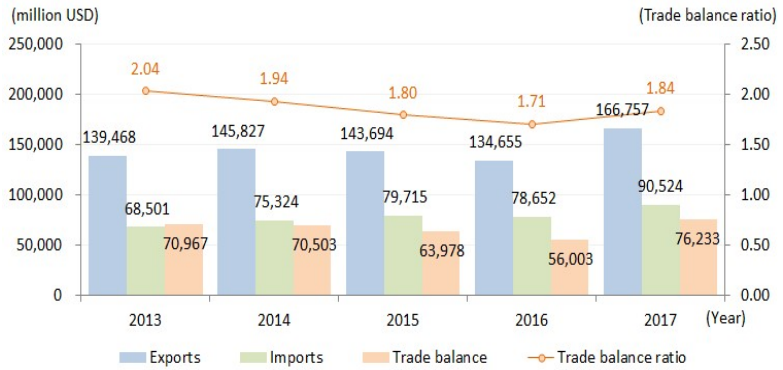
- R&D-intensive industries include pharmaceutical, computer, electronic and optical, and aerospace industries, as defined by OECD. From MSTI 2013-2, the standard industrial classification was changed from ISIC Rev.3 to ISIC Rev.4.
- Source: OECD, MSTI 2018-1 (stats.oecd.org)

76 International trade in R&D-intensive industries of major countries (2017)

	Korea	USA	Japan	Germany	France ('16)	UK	China ('16)
Exports (million USD)	172,954	380,786	108,983	201,278	127,626	110,985	637,965
Imports (million USD)	99,691	553,215	139,826	114,537	118,720	130,601	515,867
Trade balance (million USD)	73,263	-172,429	-30,844	86,741	8,906	-19,617	122,097
Trade balance ratio (Exports/Imports)	1.73	0.69	0.78	1.76	1.08	0.85	1.24

- R&D-intensive industries include pharmaceutical, computer, electronic and optical, and aerospace industries, as defined by OECD.
- Source: OECD, MSTI 2018-1 (stats.oecd.org)

77 ICT industry trade in Korea



	2014	2015	2016	2017
Exports (million USD)	145,827	143,694	134,655	166,757
Imports (million USD)	75,324	79,715	78,652	90,524
Trade balance (million USD)	70,503	63,978	56,003	76,233
Trade balance ratio (Exports/Imports)	1.94	1.80	1.71	1.84

‣ Source: OECD, STAN Bilateral Trade Database ISIC4 ed. 2018 (stats.oecd.org)

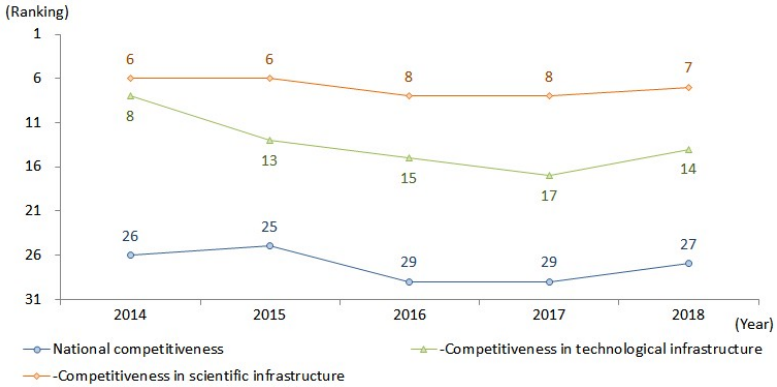
78 ICT industry trade in major countries (2017)

	Korea	USA	Japan	Germany	France	UK	China
Exports (million USD)	166,757	199,303	96,572	129,246	34,735	33,294	674,210
Imports (million USD)	90,524	402,372	106,132	134,884	53,402	63,503	510,299
Trade balance (million USD)	76,233	-203,069	-9,560	-5,639	-18,667	-30,209	163,911
Trade balance ratio (Exports/Imports)	1.84	0.50	0.91	0.96	0.65	0.52	1.32

‣ Source: OECD, STAN Bilateral Trade Database ISIC4 ed. 2018 (stats.oecd.org)

10. National Competitiveness

79 Competitiveness ranking of Korea (IMD)



	2015	2016	2017	2018
Overall competitiveness	25	29	29	27
Economic performance	15	21	22	20
Government efficiency	28	26	28	29
Business efficiency	37	48	44	43
Infrastructure	21	22	24	18
- Science	6	8	8	7
- Technology	13	15	17	14

‣ Source: IMD, The World Competitiveness Yearbook

80 Competitiveness ranking of major countries (2018, IMD)

	Korea	USA	Japan	Germany	France	UK	China
Competitiveness	27	1	25	15	28	20	13
- Science	7	1	5	6	12	9	2
- Technology	14	3	13	16	11	12	1

‣ Source : IMD, The World Competitiveness Yearbook 2018

81 Competitiveness ranking of Korea in scientific infrastructure (IMD)

	2015	2016	2017	2018
Total expenditure on R&D	6	6	5	5
Total expenditure on R&D as a percentage of GDP	2	1	2	2
Total expenditure on R&D per capita	14	14	13	14
Business expenditure on R&D	5	5	5	5
Business expenditure on R&D as a percentage of GDP	2	2	2	2
Total R&D personnel nationwide	6	6	5	6
Total R&D personnel nationwide per 1,000 people	9	8	8	8
Total R&D personnel in business enterprise	5	5	6	6
Total R&D personnel in business per 1,000 people	6	4	4	5
Researcher in R&D per 1,000 people		4	4	3
Percentage of total first university degrees in science and engineering	9	16	17	11
Scientific articles	9	9	9	9
Nobel prizes	27	28	29	29
Nobel prizes per 1,000,000 people	27	28	29	29
Number of patent applications	4	4	4	4
Number of patent applications filed per 100,000 inhabitants	3	3	3	3
Number of patents granted	4	4	4	4
Number of patents in force per 100,000 inhabitants	3	3	3	3
Value added of knowledge and technology intensive industries as a percentage of GDP		30	30	10
Scientific research is high by international standards*	19	34	27	21
Researchers/Scientists are attracted to your country*	29	34	33	31
Laws relating to scientific research do encourage innovation*	30	34	34	37
Intellectual property rights are adequately enforced*	27	38	44	39
Knowledge transfer is highly developed between companies and universities*	22	34	32	29
Innovation capacity of firms is high in your economy*	21	33	34	31
Overall Ranking	6	8	8	7

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

82 Competitiveness ranking of Korea in technological infrastructure (IMD)

	2015	2016	2017	2018
Investment in telecommunications as a percentage of GDP		52	24	47
Mobile broadband subscribers		4	12	5
Monthly telephone costs per capita		50	54	52
Communications technology*	12	12	16	14
Computers in use (worldwide share)	11	11	11	11
Number of computers per 1,000 people	18	18	18	17
Number of internet users per 1,000 people	16	16	17	16
Number of broadband subscribers per 1,000 inhabitants	5	20	22	22
Internet bandwidth speed		1	1	1
Digital technology skills are readily available*			22	26
Qualified engineers are available in labor market*	29	34	32	32
Technological cooperation between companies is developed*	35	42	45	40
Public and private sector ventures are supporting technological development*	21	36	29	37
Development and application of technology are supported by the legal environment*	31	51	47	52
Funding for technological development is readily available*	34	44	46	46
High-tech exports	5	5	6	6
High-tech exports as a percentage of manufactured exports	6	6	7	9
ICT as a percentage of total service exports	41	39	35	32
Cyber security is being adequately addressed by corporations*	39	45	49	24
Overall Ranking	13	15	17	14

‣ *Indicators by survey
‣ Source: IMD, The World Competitiveness Yearbook (www.imd.org)

83 Global competitiveness of Korea (WEF)

	2017	2018
Global competitiveness	17	15
Institutions	28	27
Infrastructure	7	6
Dissemination of ICT	1	1
Macroeconomic stability	1	1
Health	20	19
Education and technology	31	27
Product market	65	67
Labor market	47	48
Financial system	22	19
Market size	13	14
Business dynamics	22	22
Innovation capacity	10	8

‣ Rankings were calculated by new index, Global Competitiveness Index: GCI 4.0.
‣ Source: WEF, The Global Competitiveness Report, 2018 (www.weforum.org)

84 Global competitiveness ranking of major countries (2018, WEF)

Korea	USA	Japan	Germany	France	UK	China
15	1	5	3	17	8	28

‣ Source: WEF, The Global Competitiveness Report, 2018 (www.weforum.org)

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

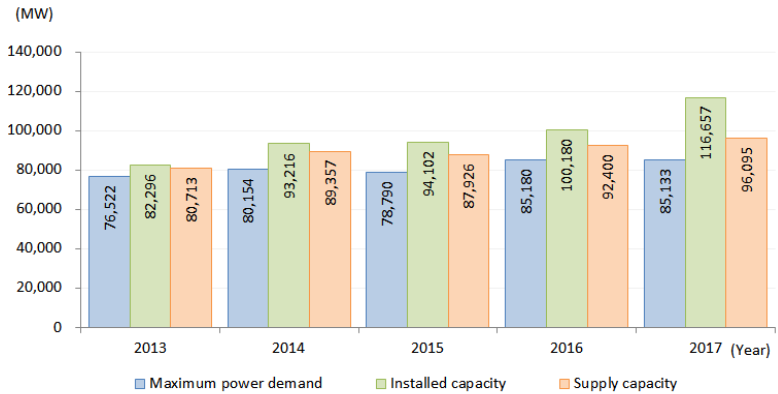
	2015		2016		2017		2018	
	Indicator (Score)	Ranking	Indicator (Score)	Ranking	Indicator (Score)	Ranking	Indicator (Score)	Ranking
COSTII	12.531	5	12.322	5	11.440	7	11.558	7
Resource	1.777	8	1.841	7	1.916	7	1.943	6
Activities	3.683	3	3.786	3	3.655	3	4.071	3
Network	1.473	9	1.475	9	1.333	13	1.405	9
Environment	2.976	23	2.646	21	2.563	23	2.533	22
Performance	1.682	12	1.724	11	1.732	13	1.606	14

‣ Source: MSIT·KISTEP, COmposite Science and Technology Innovation Index, 2018

V Other R&D Statistics

11. Energy and Resources

86 Electricity supply and demand in Korea



‣ Installed capacity and supply capacity is standardized by each year's time of occurrence for maximum power demand
‣ Source: KEPCO, Electric Power statistics (November, 2018) (home.kepco.co.kr)

87 Petroleum and LNG supply in Korea

		2014	2015	2016	2017
Petroleum	Crude oil imports (million barrels)	928	1,026	1,078	1,118
	Amount of crude oil imports (million USD)	93,907	54,679	44,295	59,603
LNG	Imports (1,000 tons)	36,322	31,410	31,895	37,537

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

88 Total primary energy supply per 1,000 USD of GDP in major countries (2017)

	Korea	USA	Japan	Germany	France	UK	China ('16)
Energy supply (toe)/ 1,000 USD (PPP)	0.16	0.12	0.09	0.09	0.10	0.07	0.15

‣ Source: OECD (2018), Primary energy supply (indicator)

89 Nuclear electricity as a percentage of total electricity generation in major countries (%, 2015)

Korea	USA	Japan	Germany	France	UK
30.2	19.3	0.9	14.2	77.7	21.0

‣ Source: World Bank, World Development Indicator

90 Overseas natural resource exploitation in Korea

		2014	2015	2016	2017
Number of overseas resource exploitation programs (cumulative)	Petroleum/Gas	372	376	378	380
	- In progress	182	166	141	131
	* Production	74	78	81	79
	* Exploitation	28	25	19	12
	* Exploration	80	63	41	40
	- Completed programs	190	210	237	249
	General minerals	519	525	533	538
	- In progress	345	334	335	322
	- Completed programs	174	191	198	216
Self-sufficient exploitation ratio (%)	Petroleum/Gas	14.0	16.0	15.0	13.0
	Bituminous coal	55.0	53.0	50.0	38.0
	Iron	18.0	15.0	28.0	26.0
	Bronze	11.0	6.0	7.0	8.0
	Zinc	21.5	21.2	22.8	20.6
	Nickel	61.7	68.9	63.2	61.8

- 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

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

	2014	2015	2016	2017
Renewable energy supply	11,537	13,293	14,178	16,448
Supply percentage (%)	4.1	4.6	4.8	5.4
Solar heat	29	28	28	28
Sunlight	547	849	1,093	1,516
Bio	2,822	2,766	2,765	3,599
Waste	6,905	8,436	8,743	9,359
Water power	581	454	603	601
Wind power	242	283	355	462
Geothermal heat	109	135	162	184
Hydrogen/Fuel cell	199	230	242	313
Marine	104	105	105	104

- 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)

92 Contribution of renewables to energy supply in major countries (%, 2017)

Korea	USA	Japan	Germany	France	UK	China ('16)
2.01	7.68	5.47	13.45	9.75	9.64	9.01

- Source: OECD(2018), Renewable energy(indicator)

93 CO_2 emissions in major countries (kg per PPP $ of GDP, 2015)

Korea	USA	Japan	Germany	France	UK	China
0.35	0.31	0.28	0.22	0.13	0.16	0.58

‣ Source: European Commision, Emissions Database for Global Atmospheric Research, 2016

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

	2012	2013	2014	2015
As a percentage of GOVERD	17.1	17.9	16.1	17.1

‣ The percentage indicates green technology R&D as a percentage of total GOVERD
‣ Source: MSIT·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 ('14)	USA ('16)	Japan ('15)	Germany ('15)	France ('15)	UK ('14)
Environment	2.3	0.4	1.9	3.1	3.3	2.3
Energy	9.1	2.0	10.8	4.9	7.1	2.5
Total	11.4	2.4	12.8	8.0	10.4	4.8

‣ Source: OECD, Science, Technology and Industry Outlook 2016 (www.oecd-ilibrary.org)

13. Space

96 Space programs as a percentage of civil GBAORD in major countries

	Korea ('16)	USA ('17)	Japan ('17)	Germany ('17)	France ('16)	UK ('16)
Civil GBAORD for space programs (million USD)	469	12,853	1,922	1,561	916	524
Space programs as a percentage of GBAORD (%)	3.3	17.6	6.4	5.0	6.3	4.5

‣ Government R&D budget does not include national defence budget.
‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)

97 BERD performed in aerospace industry in major countries

	Korea ('15)	USA ('15)	Japan ('16)	Germany ('15)	France ('13)	UK ('15)
Aerospace industry R&D expenditure (million USD)	209	27,464	711	1,893	4,125	2,232
Percentage of aerospace industry R&D expenditure in BERD (%)	0.5	7.7	0.6	2.8	10.2	7.0

‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)

14. Biotechnology

98 Biotechnology Industry in Korea

		2014	2015	2016	2017
Industry trends (trillion KRW)	Output	7.61	8.50	9.26	10.13
	Domestic demand	5.60	5.63	6.09	6.62
	Exports	3.41	4.29	4.63	5.15
	Imports	1.40	1.41	1.46	1.65
Personnel	R&D personnel	11,815	12,782	13,151	13,613
	Production personnel	12,868	13,564	14,605	15,777
	Total	24,683	26,346	27,756	29,390

‣ 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 (2017)

	Korea	USA	Japan	Germany	France	UK	China
Population (thousands)	51,446	325,703	126,728	82,679	67,106	66,051	1,390,080
GDP per capita (USD)	29,755	59,535	38,446	44,479	38,484	39,703	8,804

‣ Source: OECD, MSTI 2018-1 (stats.oecd.org)

100 Labor force, total employment, and value added of industry in major countries (2017)

	Korea	USA	Japan	Germany	France	UK	China
Labor force (thousands)	27,573	161,728	66,952	43,198	29,688	33,391	806,940 ('16)
Total employment (thousands)	26,548	155,557	67,531	44,105	27,924	32,058	776,030 ('16)
Value added of industry (100 million USD)	10,423	122,668	35,223	23,400	14,808	15,853	92,541

‣ Source: OECD, MSTI 2018-1 (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
KEPCO	Korea Electric Power Corporation
KIPO	Korea Intellectual Property Office
KSIC	Korean Standard Industrial Classification
MOE	Ministry of Education
MOTIE	Ministry of Trade, Industry & Energy
MSIT	Ministry of Science and ICT
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
WIPO	World Intellectual Property Organization

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    Korea Institute of S&T Evaluation and Planning

Ministry of Science and ICT

- Ho Won Chang hwchang@korea.kr

Researchers

- Yun-Jong Kim yjkim@kistep.re.kr
- Goeun Chung chung0506@kistep.re.kr

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