

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 July 2019.
 - 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 2019–1.
- 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 2018 and researchers is from 2017, total researchers per 1,000 labor force (FTE) was calculated only up to 2017.
- Rankings were based on data of the most recent year obtained (or recomputed).

100 Main Science & Technology Indicators of Korea

Volume 2019-1



2019



Ministry of Science and ICT



Korea Institute of S&T
Evaluation and Planning

CONTENTS

Category	Subcategory	Indicator	Page
R&D Expenditure	1. Gross Domestic Expenditure on R&D (GERD)	1. GERD in Korea	5
		2. GERD in major countries	5
		3. GERD per capita population and per researcher in Korea	6
		4. GERD per capita population and per researcher (FTE) in major countries	6
		5. GERD by performance sectors in Korea	6
		6. Percentage of GERD by performance sectors in major countries	7
		7. GERD by source of funds in Korea	7
		8. Percentage of GERD by source of funds in major countries	7
		9. GERD by type of R&D in Korea	8
		10. GERD by type of R&D in major countries	8
		11. GERD by future and emerging technologies (6T) in Korea	8
		12. GERD by region in Korea	9
	2. Business Enterprise Expenditure on R&D (BERD)	13. Percentage of BERD financed by government in Korea	10
		14. Percentage of BERD financed by government in major countries	10
		15. BERD by business type in Korea	10
		16. BERD by industry in Korea	11
		17. BERD by industry in major countries	11
		18. BERD performed in R&D-intensive industries of major countries	11
		19. BERD and its percentage relative to sales in Korea	12
		20. BERD of major countries as a percentage of value added in industry	12
		21. BERD intensity in Korea	12
		22. World's top 50 companies by BERD	13
	3. Government Intramural Expenditure on R&D (GOVERD)	23. Total GBAORD in Korea	14
		24. Total GBAORD in major countries	14
		25. GOVERD in Korea	15
		26. GOVERD by performance sectors in Korea	15
		27. GOVERD by type of R&D in Korea	15
		28. GOVERD by ministry in Korea	16
		29. GOVERD by future and emerging technologies (6T) in Korea	16
		30. GOVERD by region in Korea	17
		31. Total researchers and total R&D personnel in Korea	18
		32. Total researchers and total R&D personnel in major countries (FTE)	18
R&D Personnel	4. R&D Personnel	33. Total researchers per 10,000 population, per 1,000 total employment and per 1,000 labor force (FTE) in Korea	19
		34. Total researchers per 10,000 population, per 1,000 total employment and per 1,000 labor force (FTE) in major countries	19
		35. Researchers by sector of employment in Korea	19
		36. Percentage of researchers by sector of employment in major countries	19
		37. Women researchers in Korea	20
		38. Women researchers in major countries	20
		39. Distribution of researchers by sector of employment and qualification in Korea	20
		40. Researchers by qualification in Korea	21
		41. Researchers by field of study in Korea	21
		42. Researchers by age in Korea	21
		43. Researchers by region in Korea	22
		44. Researchers by company types in Korea	23
		45. Researchers by industry in Korea	23
		46. Researcher and doctoral researcher intensity of the top companies in Korea	23
		47. Principal investigators of government R&D projects by sector, gender, and degree in Korea	24
		48. Current and shortfall of S&T industry personnel in Korea	24
	5. Nurturing Human Capital	49. Number of students enrolled in bachelor's, master's and doctoral programs in Korea	25
		50. Number of science and engineering graduates with master's and doctoral degrees in Korea	25
		51. New doctorates in natural sciences and engineering as a percentage of all graduates in major countries	25
		52. Tertiary education graduates in natural sciences and engineering as a percentage of all graduates in major countries	25



Category	Subcategory	Indicator	Page
R&D Performance	6. Publications	53. Number of papers published in SCI journals in Korea	26
		54. Number of papers published in SCI journals in major countries	26
		55. Number of papers published in SCI journals per 10,000 population or per 100 researchers (FTE) in Korea	27
		56. Number of papers published in SCI journals per 10,000 population or per 100 researchers (FTE) in major countries	27
		57. Average citations per paper over five-year period in Korea	27
		58. Average citations per paper over five-year period in major countries	27
		59. Number of papers published in top 3 journals in Korea	28
		60. Number of papers published by region in Korea	28
	7. Patents	61. Domestic patent applications and patent grants in Korea	29
		62. Domestic patent applications and patent grants by region in Korea	29
		63. Number of triadic patent families in Korea	30
		64. Number of triadic patent families in major countries	30
		65. Number of patent applications to and grants from the USPTO in Korea	30
		66. Number of patent applications to and grants from the USPTO in major countries	30
		67. Top 10 companies granted U.S. Patents	31
		68. Number of patent applications to and grants from the EPO in Korea	31
		69. Number of patent applications to and grants from the EPO in major countries	32
		70. Number of patent applications filed under the PCT in Korea	32
		71. Number of patent applications filed under the PCT in major countries	32
		72. Number of patent applications filed under the PCT in the ICT and biotechnology sector in major countries	32
	8. Technology Trade	73. Technology balance of payments in Korea	33
		74. Technology balance of payments by industry in Korea	33
	9. International Trade in High-Tech Industries	75. International trade in R&D-intensive industries of Korea	34
		76. International trade in R&D-intensive industries of major countries	34
		77. ICT industry trade in Korea	35
		78. ICT industry trade in major countries	35
	10. National Competitiveness	79. Competitiveness ranking of Korea (IMD)	36
		80. Competitiveness ranking of major countries (IMD)	36
		81. Competitiveness ranking of Korea in scientific infrastructure (IMD)	37
		82. Competitiveness ranking of Korea in technological infrastructure (IMD)	38
		83. Global competitiveness of Korea (WEF)	39
		84. Global competitiveness ranking of major countries (WEF)	39
		85. Composite Science and Technology Innovation Index (COSTII) of Korea	39
		86. Electricity supply and demand in Korea	40
Other R&D Statistics	11. Energy and Resources	87. Petroleum and LNG supply in Korea	40
		88. Total primary energy supply per 1,000 USD of GDP in major countries	40
		89. Nuclear electricity as a percentage of total electricity generation in major countries	40
		90. Overseas natural resource exploitation in Korea	41
		91. Renewable energy supply in Korea	41
		92. Contribution of renewables to energy supply in major countries	41
	12. Green Growth and Technology	93. CO ₂ emissions in major countries (kg per PPP \$ of GDP)	42
		94. R&D budget for energy and environment as a percentage of GBAORD in major countries	42
		95. Space programs as a percentage of civil GBAORD in major countries	42
	13. Space	96. BERD performed in aerospace industry in major countries	42
		97. R&D expenditure in Biotechnology by company in major countries	42
	14. Biotechnology	98. Biotechnology industry in Korea	43
		99. Population and GDP per capita in major countries	43
	15. Economic Indicators	100. Labor force, total employment, and value added of industry in major countries	43

I Main Science and Technology Indicators

1. R&D Expenditure and Personnel

		Korea (^{'17})	USA (^{'17})	Japan (^{'17})	Germany (^{'17})	France (^{'17})	UK (^{'17})	China (^{'17})
R&D Expenditure	Gross Domestic Expenditure on R&D (100 million USD)	697 (5 th)	5,432 (1 st)	1,561 (3 rd)	1,122 (4 th)	565 (6 th)	439 (7 th)	2,605 (2 nd)
	– Ratio	1.00	7.79	2.24	1.61	0.81	0.63	3.74
	– As a percentage of GDP (%)	4.55	2.79	3.21	3.04	2.19	1.66	2.15
	– Government · Public: Private · Foreign Ratio (%)	23:77	30:70	21:79	28:72	37:63 (^{'16})	33:67 (^{'16})	20:77
	Government Expenditure on R&D (100 million USD)	179 (^{'18})	1,305 (^{'18})	342 (^{'18})	368 (^{'18})	184 (^{'18})	140	–
	– As a percentage of GDP (%)	1.11	0.64	0.69	0.92	0.66	0.53	–
R&D Personnel	Total Researchers (1,000 FTE)	383	1,371 (^{'16})	676	420	289	290	1,740
	Total Researchers per 1,000 labor force (FTE)	13.9	8.5 (^{'16})	10.1	9.7	9.7	8.7	2.2

► Rankings were based on the data of the most recent year obtained from OECD Main Science & Technology Indicators 2019–1, 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: 19.7 trillion KRW (^{'18})

2. R&D Performance

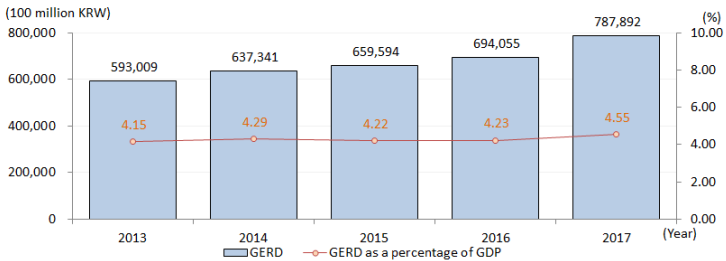
		Korea	USA	Japan	Germany	France	UK	China
Publications (^{'17})	SCI Papers	60,529 (12th)	439,781 (1st)	82,797 (5th)	118,447 (4th)	79,879 (6th)	136,231 (3rd)	345,345 (2nd)
	Number of triadic patent families (^{'17})	2,428 (5th)	12,021 (2nd)	17,591 (1st)	4,531 (3rd)	2,315 (6th)	1,612 (7th)	4,215 (4th)
Patents	Number of patent applications to the PCT (^{'18})	17,013 (5th)	56,096 (1st)	49,709 (3rd)	19,756 (4th)	7,920 (6th)	5,633 (7th)	53,349 (2nd)
R&D-intensive industries (^{'18})	Receipts (A, 100 million USD)	1,981	3,984	1,142	2,900	1,390	1,075	6,966 (^{'17})
	Payments (B, 100 million USD)	1,056	5,946	1,498	2,359	1,191	1,293	5,676 (^{'17})
	Balance of payments ratio (A/B)	1.88	0.67	0.76	1.23	1.17	0.83	1.23 (^{'17})
	Balance of payments (100 million USD)	925	–1,962	–357	542	199	–218	1,290 (^{'17})
IMD evaluation (^{'19})	Competitiveness ranking	28	3	30	17	31	23	14
	– Science	3	1	6	5	12	11	2
	– Technology	22	6	20	23	9	12	2

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)	476,452	495,098	516,254	543,249
	As a percentage of GDP (%)	2.72	2.72	2.76	2.79
Japan	GERD (million USD)	164,925	144,047	155,447	156,128
	As a percentage of GDP (%)	3.40	3.28	3.16	3.21
Germany	GERD (million USD)	111,773	98,465	101,958	112,186
	As a percentage of GDP (%)	2.87	2.91	2.92	3.04
France	GERD (million USD)	64,913	55,275	54,792	56,523
	As a percentage of GDP (%)	2.28	2.27	2.22	2.19
UK	GERD (million USD)	50,351	48,317	44,731	43,889
	As a percentage of GDP (%)	1.66	1.67	1.68	1.66
China	GERD (million USD)	211,862	227,538	235,936	260,494
	As a percentage of GDP (%)	2.03	2.07	2.12	2.15

► GERD is calculated by applying GERD in MSTI 2019-1 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 2019-1 (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	1,541	1,595	1,666
	Japan	1,296	1,133	1,225	1,232
	Germany	1,380	1,205	1,238	1,357
	France	979	830	820	843
	UK	779	742	681	665
	China	155	166	171	187
GERD per researcher (FTE) (USD)	Korea	175,210	163,591	165,545	181,933
	USA	355,580	361,579	376,473	
	Japan	241,494	217,571	233,556	230,859
	Germany	317,606	253,787	255,147	267,354
	France	238,850	199,095		195,865
	UK	182,045	169,843	154,822	151,512
	China	138,992	140,540	139,428	149,671

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

▶ Source: OECD, MSTI 2019-1 (stats.oecd.org)

MSIT · KISTEP, Survey of Research and Development in Korea

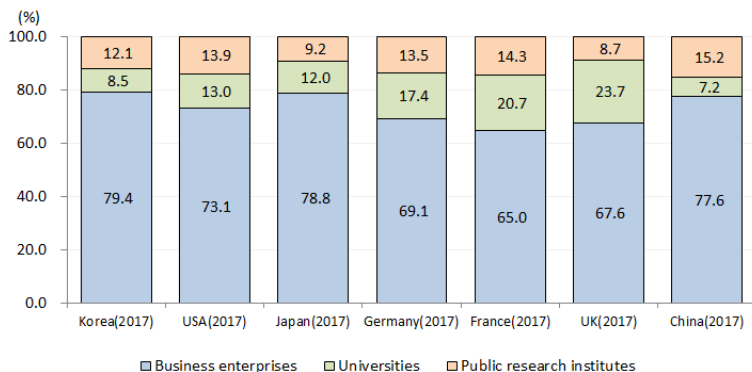
⑤ GERD by performance sectors in Korea

	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 2019-1 (stats.oecd.org)

MSIT · KISTEP, Survey of Research and Development in Korea

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 (^{'17})	Japan (^{'17})	Germany (^{'17})	France (^{'16})	UK (^{'16})	China (^{'17})
Government	22.5	30.3	21.1	28.1	36.7	32.6	19.8
Private	76.2	63.6	78.3	66.2	55.6	51.8	76.5
Abroad	1.3	6.2	0.6	5.8	7.7	15.6	0.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	96.9

► The sum of Government, Private and Abroad of China is less than 100.0%.

► Source: OECD, MSTI 2019-1 (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 (¹⁷)	Japan (¹⁷)	France (¹⁵)	UK (¹⁶)	China (¹⁷)
Basic research	14.5	17.0	13.1	23.8	18.1	5.5
Applied research	22.0	20.3	18.7	37.9	44.0	10.5
Development research	63.6	62.5	63.9	35.2	37.9	84.0

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

► Source: OECD, Research and Development Statistics, 2019 (stats.oecd.org)

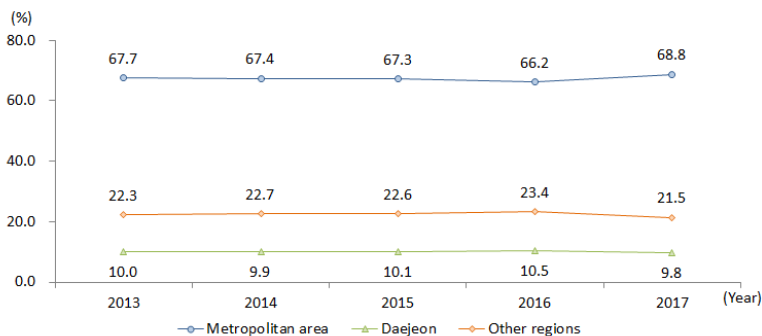
MSIT · KISTEP, Survey of Research and Development in Korea, 2017

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	85,499	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 are 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	6.7	6.3
Japan	1.1	1.2	1.0	1.0
Germany	3.6	3.6	3.6	3.3
France	7.9	8.9	8.3	
UK	10.0	9.3	8.6	
China	4.2	4.3	3.7	3.4

▶ Source: OECD, MSTI 2019–1 (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 are 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 K SIC classification standard has been applied from 2016.

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

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	32.1	11.8	14.2	46.4	58.8

► Source: OECD, Research and Development Statistics, 2019 (stats.oecd.org)
MSIT · KISTEP, Survey of Research and Development in Korea, 2017

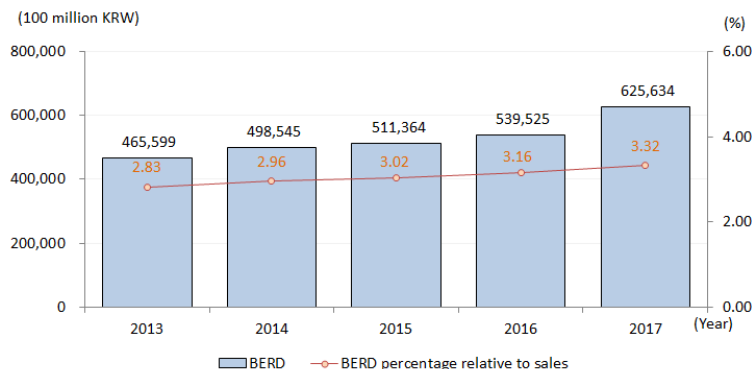
18 BERD performed in R&D-intensive industries of major countries

	Korea (¹⁵)	USA (¹⁶)	Japan (¹⁷)	Germany (¹⁵)	France (¹⁶)	UK (¹⁶)
BERD (million USD)	24,061	168,658	37,644	14,644	8,345	4,223
Percentage (%)	53.2	45.0	30.6	21.7	23.4	14.1

► OECD defines R&D-intensive industries as pharmaceutical, computer, electronic and optical, and aerospace industry.

► Source: OECD, MSTI 2019-1 (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 (2017)

	Korea	USA	Japan	Germany	France	UK	China
BERD as a percentage of value added in industry (%)	5.31	3.21	3.49	3.31	2.49	1.87	2.25

► Source: OECD, Main Science & Technology Indicators 2019-1 (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)

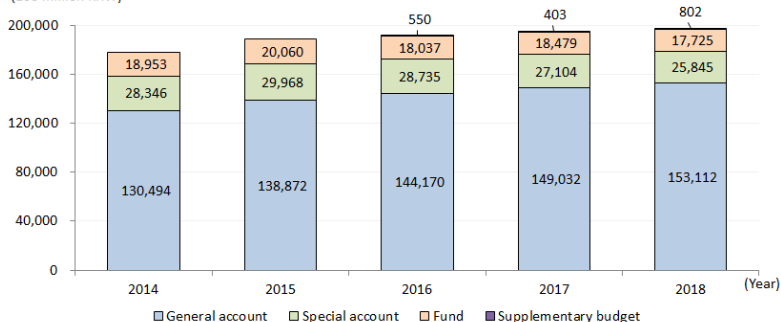
Rank	Name	Country	Rank	Name	Country
1	SAMSUNG ELECTRONICS	Korea	26	BRISTOL-MYERS SQUIBB	USA
2	ALPHABET	USA	27	NOKIA	Finland
3	VOLKSWAGEN	Germany	28	QUALCOMM	USA
4	MICROSOFT	USA	29	ASTRAZENECA	UK
5	HUAWEI	China	30	GLAXOSMITHKLINE	UK
6	INTEL	USA	31	FIAT CHRYSLER AUTOMOBILES	Netherlands
7	APPLE	USA	32	IBM	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: EC, The 2018 EU Industrial R&D Investment Scoreboard (ir.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

(100 million KRW)



	2015	2016	2017	2018
General account (100 million KRW)	138,872	144,170	149,032	153,112
Special account (100 million KRW)	29,968	28,735	27,104	25,845
Funds (100 million KRW)	20,060	18,037	18,479	17,725
Supplementary budget (100 million KRW)		550	403	802
Total GBAORD (100 million KRW)	188,900	191,492	195,018	197,483

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

24 Total GBAORD in major countries (2018)

	Korea	USA	Japan	Germany	France	UK (¹⁷)
Total GBAORD (million USD)	17,944	130,541	34,192	36,802	18,367	13,964
As a percentage of GDP (%)	1.11	0.64	0.69	0.92	0.66	0.53

► Source: OECD, MSTI 2019–1 (stats.oecd.org)
MSTI - KISTEP, Governmental R&D Survey and Analysis

25 GOVERD in Korea

	2015	2016	2017	2018
GOVERD (100 million KRW)	188,747	190,044	193,927	197,759
Number of projects	54,433	54,827	61,280	63,697

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

26 GOVERD by performance sectors in Korea

	2015		2016		2017		2018	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Research institutes	87,814	46.5	88,188	46.4	88,853	45.8	90,747	45.9
Universities	42,617	22.6	42,727	22.5	44,052	22.7	45,365	22.9
Business enterprises	40,310	21.4	41,286	21.7	45,382	23.4	46,694	23.6
Ministries	6,181	3.3	6,281	3.3	4,692	2.4	2,993	1.5
Others	11,825	6.3	11,562	6.1	10,948	5.6	11,960	6.0
Total	188,747	100.0	190,044	100.0	193,927	100.0	197,759	100.0

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

27 GOVERD by type of R&D in Korea

	2015		2016		2017		2018	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Basic research	43,118	32.3	43,713	32.5	45,898	33.5	44,651	32.7
Applied research	25,316	19.0	25,428	18.9	26,233	19.1	27,665	20.2
Development research	65,142	48.8	65,362	48.6	65,021	47.4	64,387	47.1
Total	133,577	100.0	134,502	100.0	137,152	100.0	136,703	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

	2017		2018	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Ministry of Science and ICT	67,950	35.0	66,779	33.8
Ministry of Education	17,349	8.9	17,382	8.8
Prime Minister Office	4,554	2.3	5,022	2.5
Ministry of National Defence	380	0.2	456	0.2
Ministry of Land, Infrastructure and Transport	4,709	2.4	4,565	2.3
Korea Meteorological Administration	1,285	0.7	1,329	0.7
Ministry of Agriculture, Food and Rural Affairs	2,095	1.1	1,973	1.0
Rural Development Administration	6,366	3.3	6,454	3.3
Cultural Heritage Administration	403	0.2	451	0.2
Ministry of Culture, Sports and Tourism	739	0.4	744	0.4
Defense Acquisition Program Administration	27,376	14.1	29,442	14.9
Ministry of Health and Welfare	5,141	2.7	5,150	2.6
Korea Forest Service	1,038	0.5	1,020	0.5
Ministry of Trade, Industry and Energy	31,181	16.1	31,059	15.7
Ministry of Food and Drug Safety	838	0.4	847	0.4
Nuclear Safety and Security Commission	645	0.3	692	0.3
Ministry of SMEs and Startups	11,787	6.1	10,426	5.3
Ministry of Oceans and Fisheries	5,935	3.1	6,126	3.1
Ministry of Environment	2,875	1.5	3,331	1.7
Others	1,281	0.7	4,513	2.3
Total	193,927	100.0	197,759	100.0

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

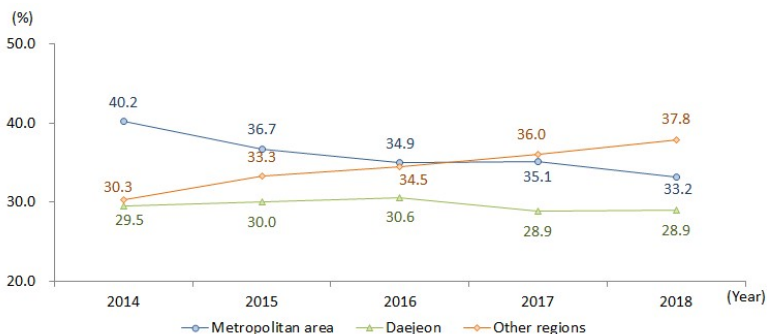
29 GOVERD by future and emerging technologies (6T) in Korea

	2015		2016		2017		2018	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Information Technology (IT)	33,368	19.0	33,617	19.0	33,465	18.5	33,451	18.1
Biotechnology (BT)	33,019	18.8	33,341	18.8	34,946	19.3	35,494	19.2
Nanotechnology (NT)	7,965	4.5	8,003	4.5	8,266	4.6	8,133	4.4
Space Technology (ST)	10,605	6.1	12,512	7.1	14,487	8.0	14,875	8.1
Environment Technology (ET)	23,928	13.7	22,697	12.8	22,924	12.7	22,294	12.1
Culture Technology (CT)	1,758	1.0	1,963	1.1	2,221	1.2	2,423	1.3
Others	64,557	36.8	64,871	36.6	64,521	35.7	67,919	36.8
Total	175,199	100.0	177,005	100.0	180,831	100.0	184,589	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



	2015		2016		2017		2018	
	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)	GOVERD (100 million KRW)	Percentage (%)
Seoul	36,485	20.1	35,925	19.6	37,019	19.2	36,175	18.5
Busan	6,078	3.3	6,572	3.6	7,798	4.0	8,765	4.5
Daegu	5,465	3.0	5,661	3.1	6,104	3.2	6,233	3.2
Incheon	4,174	2.3	4,385	2.4	4,281	2.2	4,087	2.1
Gwangju	4,560	2.5	4,573	2.5	4,469	2.3	4,474	2.3
Daejeon	54,584	30.0	56,115	30.6	55,630	28.9	56,655	28.9
Ulsan	2,808	1.5	2,691	1.5	2,836	1.5	3,031	1.5
Sejong	3,682	2.0	4,170	2.3	4,234	2.2	4,696	2.4
Gyeonggi	26,112	14.4	23,740	12.9	26,326	13.7	24,763	12.7
Gangwon	2,673	1.5	2,654	1.4	2,781	1.4	2,804	1.4
Chungbuk	4,820	2.7	4,962	2.7	5,446	2.8	5,863	3.0
Chungnam	4,662	2.6	4,843	2.6	4,861	2.5	5,301	2.7
Jeonbuk	5,154	2.8	6,712	3.7	7,642	4.0	7,238	3.7
Jeonnam	3,005	1.7	3,057	1.7	2,736	1.4	2,724	1.4
Gyeongbuk	7,006	3.9	6,165	3.4	6,451	3.3	6,299	3.2
Gyeongnam	9,403	5.2	9,721	5.3	12,832	6.7	15,351	7.8
Jeju	1,136	0.6	1,410	0.8	1,242	0.6	1,286	0.7
Total	181,807	100.0	183,355	100.0	192,687	100.0	195,744	100.0

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

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

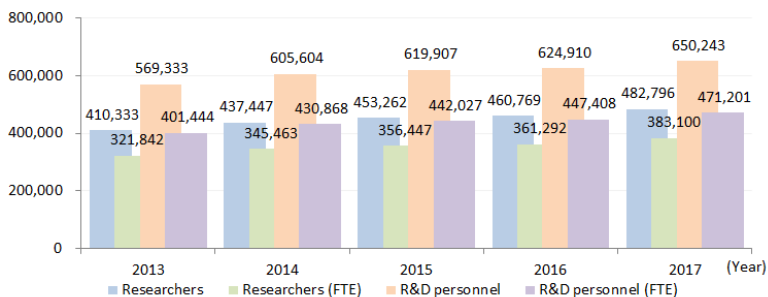
III

R&D Personnel

4. R&D Personnel

31 Total researchers and total R&D personnel in Korea

(Persons)



► 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	1,339,931	1,369,267	1,371,290	
	Japan	682,935	662,071	665,566	676,292
	Germany	351,923	387,982	399,605	419,617
	France	271,772	277,631		288,579
	UK	276,584	284,483	288,922	289,674
	China	1,524,280	1,619,028	1,692,176	1,740,442
Total R&D personnel (FTE)	Korea	430,868	442,027	447,408	471,201
	Japan	895,285	875,005	872,340	890,749
	Germany	605,252	640,516	657,894	686,349
	France	423,903	428,643		434,670
	UK	396,281	413,860	417,390	424,510
	China	3,710,580	3,758,848	3,878,057	4,033,597

► Source: OECD, MSTI 2019–1 (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 ('16)	Japan ('17)	Germany ('17)	France ('17)	UK ('17)	China ('17)
Researchers per 10,000 population (FTE)	74.5	42.4	53.4	50.8	43.0	43.9	12.5
Researchers per 1,000 total employment (FTE)	14.4	8.9	10.0	9.5	10.3	9.0	2.2
Researchers per 1,000 labor force (FTE)	13.9	8.5	10.1	9.7	9.7	8.7	2.2

► Source: OECD, MSTI 2019–1 (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 ('17)	France ('17)	UK ('17)	China ('17)
Business enterprises	81.3	73.7	60.3	37.9	60.7
Universities	10.1	20.5	28.3	58.2	18.8
Public research institutes	8.5	5.7	11.5	3.9	20.5

► Source: OECD, Research and Development Statistics, 2019 (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

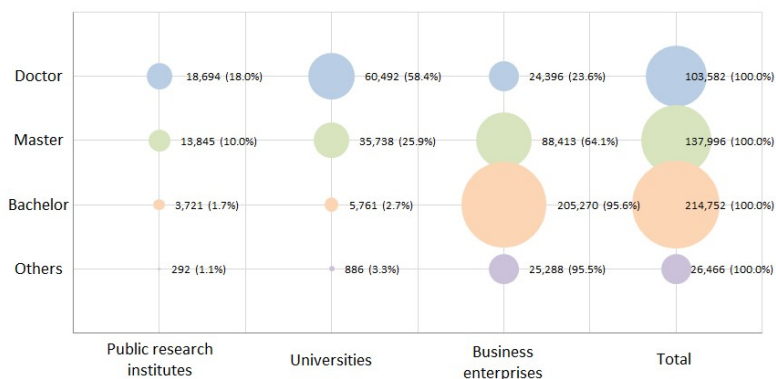
► Source: MSIT · KISTEP, Survey of Research and Development in Korea

38 Women researchers in major countries

	Korea (^{'17})	Japan (^{'17})	Germany (^{'17})	France (^{'15})	UK (^{'16})
Women researchers	97,042	150,545	173,700	103,521	197,576
As a percentage of total researchers (%)	20.1	16.2	27.9	27.0	38.7

► Source: OECD, MSTI 2019–1 (stats.oecd.org)
MSIT · KISTEP, Survey of Research and Development in Korea, 2017

39 Distribution of 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 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

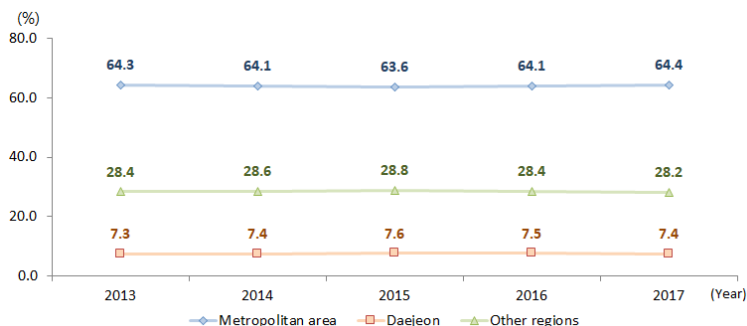
► Source: MSIT · KISTEP, Survey of Research and Development in Korea

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 are 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

		2015		2016		2017		2018	
		Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)	Researchers	Percentage (%)
Sector	Research institutes	5,612	16.3	5,690	16.0	5,829	14.2	5,970	13.7
	Universities	16,983	49.2	17,228	48.3	20,668	50.5	21,639	49.5
	Business enterprises	10,315	29.9	11,002	30.9	12,892	31.5	14,512	33.2
	Others	1,553	4.5	1,654	4.6	1,498	3.7	1,519	3.5
	Ministries	46	0.1	61	0.2	61	0.1	60	0.1
	Total	34,509	100.0	35,635	100.0	40,948	100.0	43,700	100.0
Gender	Male	29,309	85.8	30,102	85.4	34,013	83.9	36,002	83.2
	Female	4,836	14.2	5,147	14.6	6,533	16.1	7,252	16.8
	Total	34,145	100.0	35,249	100.0	40,546	100.0	43,254	100.0
Degree	Doctor	24,194	70.9	25,102	71.2	29,284	72.2	30,122	69.6
	Master	4,929	14.4	4,936	14.0	4,711	11.6	5,122	11.8
	Bachelor and under	5,022	14.7	5,211	14.8	6,551	16.2	8,010	18.5
	Total	34,145	100.0	35,249	100.0	40,546	100.0	43,254	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	2017
Current personnel	1,594,398	1,617,053	1,634,346
Shortfall of personnel	36,933	36,271	36,908
Percentage of shortfall (%)	2.3	2.2	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.kedu.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.kedu.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)

	Korea	USA	Japan	Germany	France	UK
2005	37.8	15.7	24.8	31.2	27.1	23.8
2015	29.5	17.4	21.0	36.8	25.3	26.1

► 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 (2003–2017)

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: OECD, Main Science & Technology Indicators 2019-1 (stats.oecd.org)
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	13.49	6.53	14.33	11.91	20.63	2.48
Number of papers (SCI) per 100 researchers (FTE)	15.80	32.35 ('16)	12.24	28.23	27.68	47.03	19.84

► Source: OECD, Main Science & Technology Indicators 2019-1 (stats.oecd.org)
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

	2015	2016	2017	2018
Patent applications	213,694	208,830	204,775	209,992
Patent grants	101,873	108,875	120,662	119,012

► Source: KIPO (kipo.go.kr)

62 Domestic patent applications and patent grants by region in Korea

	Patent applications				Patent grants			
	2015	2016	2017	2018	2015	2016	2017	2018
Seoul	48,030	47,288	45,482	47,123	22,305	25,087	27,527	25,224
Busan	5,786	5,989	6,422	6,172	2,281	2,527	3,061	3,412
Daegu	4,864	4,735	4,779	4,619	2,043	2,365	2,612	2,519
Incheon	6,633	5,989	6,195	6,236	3,214	3,307	3,400	3,499
Gwangju	3,074	3,321	3,279	3,431	1,298	1,410	1,694	1,765
Daejeon	11,283	10,811	10,734	10,767	5,238	5,492	6,503	5,877
Ulsan	2,553	2,421	2,267	2,347	911	1,016	1,269	1,308
Sejong	462	548	736	811	198	249	307	394
Gyeonggi	52,542	48,764	46,133	47,175	22,750	23,381	24,820	25,440
Gangwon	2,571	2,410	2,572	2,666	1,090	1,291	1,459	1,479
Chungbuk	3,440	3,498	3,166	3,509	1,431	1,670	1,861	1,921
Chungnam	6,309	6,578	6,046	6,482	2,996	3,008	3,492	3,808
Jeonbuk	4,007	3,993	4,121	3,995	1,338	1,468	1,860	1,995
Jeonnam	2,660	2,700	2,902	3,223	1,079	1,201	1,616	1,605
Gyeongbuk	6,858	7,048	6,764	6,634	4,491	4,594	4,633	4,176
Gyeongnam	5,548	6,625	6,609	6,521	2,840	3,538	3,738	3,751
Jeju	630	689	817	837	290	305	384	412
Others	23	17	7	13	525	491	611	642
Total	167,273	163,424	159,031	162,561	76,318	82,400	90,847	89,227

► 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

	2014	2015	2016	2017
Triadic patent families	2,400	2,314	2,447	2,428
Triadic patent families per million population	47.3	45.4	47.8	47.2
Triadic patent families per 10,000 researchers (FTE)	69.5	64.9	67.7	63.4

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

► Source: OECD, MSTI 2019–1 (stats.oecd.org)

64 Number of triadic patent families in major countries (2017)

	Korea	USA	Japan	Germany	France	UK	China
Triadic patent families	2,428	12,021	17,591	4,531	2,315	1,612	4,215
Triadic patent families per million population	47.2	36.9	138.8	54.8	34.5	24.4	3.0
Triadic patent families per 10,000 researchers (FTE)	63.4	89.5 ('16)	260.1	108.0	80.2	55.7	24.2

► Source: OECD, MSTI 2019–1 (stats.oecd.org)

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

	2014	2015	2016	2017
Patent applications	36,744	38,205	37,341	35,565
Patent grants	16,469	17,924	19,494	20,717

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

► Source: WIPO, WIPO Statistics Database, 2019,07 (ipstats.wipo.int)

66 Number of patent applications to and grants from the USPTO in major countries (2017)

	Korea	USA	Japan	Germany	France	UK	China
Patent applications	35,565	293,904	86,113	30,783	12,584	14,057	29,674
Patent grants	20,717	150,949	49,677	16,846	6,816	6,635	13,243

► 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: WIPO, WIPO Statistics Database, 2019,07 (ipstats.wipo.int)

67 Top 10 companies granted U.S. Patents

Rank	2017		2018	
	Number of patents	Company	Number of patents	Company
1	9,043	INTERNATIONAL BUSINESS MACHINES CORPORATION	9,100	INTERNATIONAL BUSINESS MACHINES CORPORATION
2	5,837	SAMSUNG ELECTRONICS CO., LTD.	5,850	SAMSUNG ELECTRONICS CO., LTD.
3	3,285	CANON KABUSHIKI KAISHA	3,056	CANON KABUSHIKI KAISHA
4	3,023	INTEL CORPORATION	2,735	INTEL CORPORATION
5	2,701	LG ELECTRONICS INC.	2,474	LG ELECTRONICS INC.
6	2,628	QUALCOMM, INC.	2,465	TAIWAN SEMICONDUCTOR MANUFACTURING
7	2,457	Google LLC	2,353	MICROSOFT TECHNOLOGY LICENSING, LLC.
8	2,441	MICROSOFT TECHNOLOGY LICENSING, LLC.	2,300	QUALCOMM, INC.
9	2,425	TAIWAN SEMICONDUCTOR MANUFACTURING	2,160	APPLE INC.
10	2,273	SAMSUNG DISPLAY Co., Ltd.	2,123	FORD GLOBAL TECHNOLOGIES LLC

► Source: USPTO ([uspto.gov](https://www.uspto.gov))

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

	2015	2016	2017	2018
Patent applications	6,166	6,407	6,687	6,457
Patent grants	1,891	1,993	3,210	4,435

► Source: EPO, Annual Report 2018 ([epo.org](https://www.epo.org))

69 Number of patent applications to and grants from the EPO in major countries (2018)

	Korea	USA	Japan	Germany	France	UK	China
Patent applications	7,296	43,612	22,615	26,734	10,317	5,736	9,401
Patent grants	6,262	31,136	21,343	20,804	8,610	3,827	4,831

► Source: EPO, Annual Report 2018 (epo.org)

70 Number of patent applications filed under the PCT in Korea

2015	2016	2017	2018
14,564	15,555	15,751	17,013

► 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, 2019.07 (ipstats.wipo.int)

71 Number of patent applications filed under the PCT in major countries (2018)

	Korea	USA	Japan	Germany	France	UK	China
PCT	17,013	56,096	49,709	19,756	7,920	5,633	53,349
Rank	5	1	3	4	6	7	2

► Source: WIPO, WIPO Statistics Database, 2019.07 (ipstats.wipo.int)

72 Number of patent applications filed under the PCT in the ICT and biotechnology sector in major countries (2017)

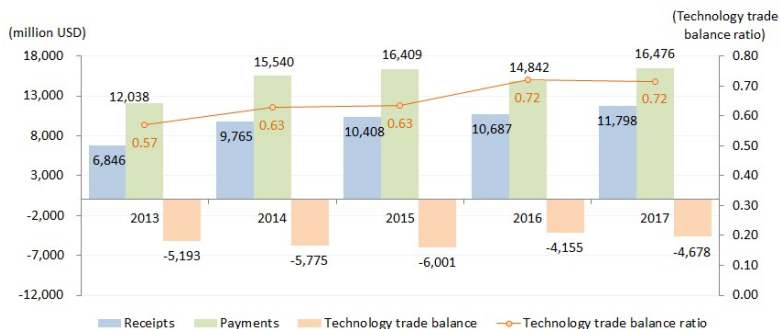
	Korea	USA	Japan	Germany	France	UK	China
ICT	5,317	17,831	11,840	2,850	1,335	1,459	23,368
Biotechnology	881	5,883	1,684	645	523	518	1,234

► The number of patent applications by priority year

► Source: OECD, MSTI 2019–1 (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 (www.koita.or.kr)

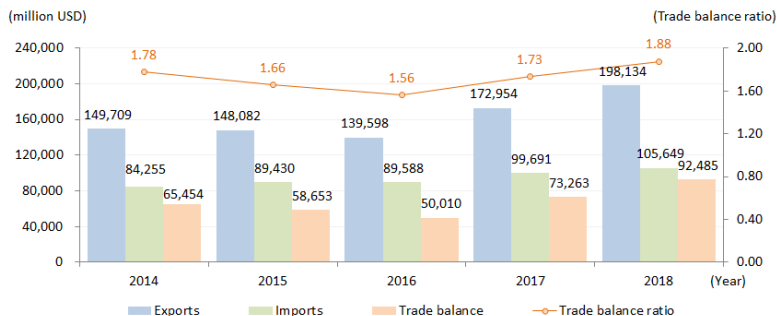
74 Technology balance of payments by industry in Korea

	Receipts (million USD)		Payments (million USD)		Balance of payments (million USD)		Balance of payments ratio (receipts/payments)	
	2016	2017	2016	2017	2016	2017	2016	2017
ICT	3,678	4,597	7,738	8,516	837	515	1.29	1.13
Electrical electronics	3,672	4,315	2,840	4,082	-4,065	-4,200	0.47	0.51
Machine	1,284	1,308	1,889	1,593	-605	-285	0.68	0.82
Chemistry	826	332	656	532	170	-200	1.26	0.62
Construction	248	134	339	366	100	35	1.67	1.35
Agriculture, forestry and fisheries	89	64	158	175	-69	-111	0.56	0.36
Textiles	66	64	150	103	-273	-302	0.19	0.17
Materials	26	15	148	99	-124	-88	0.17	0.15
Others	798	970	924	1,011	-126	-41	0.86	0.96

▶ Source: MSIT · Korea Industrial Technology Association, Statistics Report on the Technology Trade of Korea (www.koita.or.kr)

9. International Trade in High-Tech Industries

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



	2015	2016	2017	2018
Exports (million USD)	148,082	139,598	172,954	198,134
Imports (million USD)	89,430	89,588	99,691	105,649
Trade balance (million USD)	58,653	50,010	73,263	92,485
Trade balance ratio (Exports/Imports)	1.66	1.56	1.73	1.88

► 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 2019–1 (stats.oecd.org)

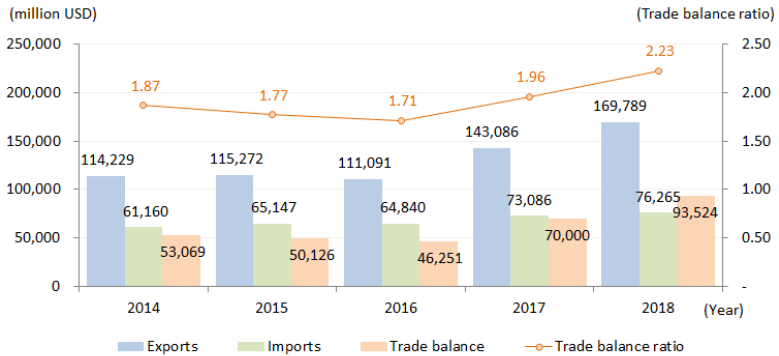
76 International trade in R&D-intensive industries of major countries (2018)

	Korea	USA	Japan	Germany	France	UK	China ('17)
Exports (million USD)	198,134	398,409	114,156	290,045	138,953	107,483	696,581
Imports (million USD)	105,649	594,644	149,831	235,865	119,099	129,271	567,564
Trade balance (million USD)	92,485	-196,235	-35,675	54,180	19,854	-21,788	129,018
Trade balance ratio (Exports/Imports)	1.88	0.67	0.76	1.23	1.17	0.83	1.23

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

► Source: OECD, MSTI 2019–1 (stats.oecd.org)

77 ICT industry trade in Korea



	2015	2016	2017	2018
Exports (million USD)	115,272	111,091	143,086	169,789
Imports (million USD)	65,147	64,840	73,086	76,265
Trade balance (million USD)	50,126	46,251	70,000	93,524
Trade balance ratio (Exports/Imports)	1.77	1.71	1.96	2.23

► Source: OECD, STAN Bilateral Trade Database ISIC4 ed, 2019 (stats.oecd.org)

78 ICT industry trade in major countries (2018)

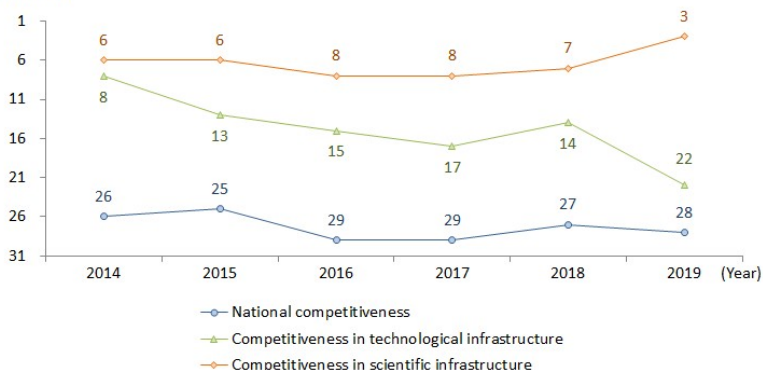
	Korea	USA	Japan	Germany	France	UK	China
Exports (million USD)	169,789	150,829	66,572	79,415	22,869	19,184	616,007
Imports (million USD)	76,265	357,233	89,698	113,661	40,769	54,627	429,411
Trade balance (million USD)	93,524	-206,403	-23,126	-34,246	-17,899	-35,443	186,596
Trade balance ratio (Exports/Imports)	2.23	0.42	0.74	0.70	0.56	0.35	1.43

► Source: OECD, STAN Bilateral Trade Database ISIC4 ed, 2019 (stats.oecd.org)

10. National Competitiveness

79 Competitiveness ranking of Korea (IMD)

(Ranking)



	2016	2017	2018	2019
Overall competitiveness	29	29	27	28
Economic performance	21	22	20	27
Government efficiency	26	28	29	31
Business efficiency	48	44	43	34
Infrastructure	22	24	18	20
– Science infrastructure	8	8	7	3
– Technology infrastructure	15	17	14	22

▶ Source: IMD, The World Competitiveness Yearbook (www.imd.org)

80 Competitiveness ranking of major countries (2019, IMD)

	Korea	USA	Japan	Germany	France	UK	China
Competitiveness	28	3	30	17	31	23	14
–Science infrastructure	3	1	6	5	12	11	2
–Technology infrastructure	22	6	20	23	9	12	2

▶ Source : IMD, The World Competitiveness Yearbook 2019 (www.imd.org)

81 Competitiveness ranking of Korea in scientific infrastructure (IMD)

	2016	2017	2018	2019
Total expenditure on R&D	6	5	5	5
Total expenditure on R&D as a percentage of GDP	1	2	2	1
Total expenditure on R&D per capita	14	13	14	9
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	5	6	6
Total R&D personnel nationwide per 1,000 people	8	8	8	5
Total R&D personnel in business enterprise	5	6	6	6
Total R&D personnel in business per 1,000 people	4	4	5	3
Researcher in R&D per 1,000 people	4	4	3	2
Percentage of total first university degrees in science and engineering	16	17	11	11
Scientific articles	9	9	9	9
Nobel prizes	28	29	29	29
Nobel prizes per 1,000,000 people	28	29	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	4
Medium- and high-tech value added	–	–	–	4
Laws relating to scientific research do encourage innovation*	34	34	37	34
Intellectual property rights are adequately enforced*	38	44	39	37
Knowledge transfer is highly developed between companies and universities*	34	32	29	35
Overall Ranking	8	8	7	3

► *Indicators by survey

► Source: IMD, The World Competitiveness Yearbook (www.imd.org)

82 Competitiveness ranking of Korea in technological infrastructure (IMD)

	2016	2017	2018	2019
Investment in telecommunications as a percentage of GDP	52	24	47	46
Mobile broadband subscribers	4	12	5	10
Monthly telephone costs per capita	50	54	52	57
Communications technology*	12	16	14	12
Computers in use (worldwide share)	11	11	11	11
Number of computers per 1,000 people	18	18	17	17
Number of internet users per 1,000 people	16	17	16	16
Number of broadband subscribers per 1,000 inhabitants	20	22	22	21
Internet bandwidth speed	1	1	1	27
Digital technology skills are readily available*		22	26	26
Qualified engineers are available in labor market*	34	32	32	31
Public and private sector ventures are supporting technological development*	36	29	37	41
Development and application of technology are supported by the legal environment*	51	47	52	50
Funding for technological development is readily available*	44	46	46	42
High-tech exports	5	6	6	8
High-tech exports as a percentage of manufactured exports	6	7	9	19
ICT as a percentage of total service exports	39	35	32	28
Cyber security is being adequately addressed by corporations*	45	49	24	23
Overall Ranking	15	17	14	22

► *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
ICT adoption	1	1
Macroeconomic stability	1	1
Health	20	19
Skills	31	27
Product market	65	67
Labor market	47	48
Financial system	22	19
Market size	13	14
Business dynamism	22	22
Innovation capability	10	8

► New ranking was calculated by 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)

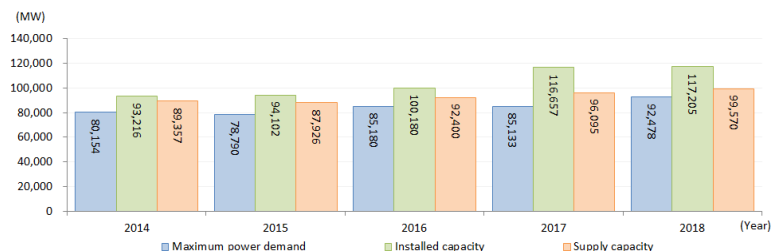
85 Composite Science and Technology Innovation Index (COSTII) of Korea

	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, COSTII, 2018

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 (June, 2019) (home.kepco.co.kr)

87 Petroleum and LNG supply in Korea

		2015	2016	2017	2018
Petroleum	Crude oil imports (million barrels)	1,026	1,078	1,118	1,116
	Amount of crude oil imports (million USD)	55,120	44,295	59,603	80,393
LNG	Imports (1,000 tons)	33,366	33,453	37,537	44,015

▶ Source: Statistics Korea (Korea National Oil Corporation, Korea Gas Corporation, and Korea Customs)(www.index.go.kr)

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 (% , 2016)

Korea	USA	Japan	Germany	France	UK
28.8	19.4	1.7	13.0	72.5	21.1

▶ Source: International Energy Agency, World Energy Statistics 2018

90 Overseas natural resource exploitation in Korea

		2015	2016	2017	2018
Number of overseas resource exploitation programs (cumulative)	Petroleum/Gas	376	378	380	380
	– In progress	166	141	131	122
	* Production	78	81	79	73
	* Exploitation	25	19	12	11
	* Exploration	63	41	40	38
	– Completed programs	210	237	249	258
	General minerals	525	533	538	544
	– In progress	334	335	322	316
	– Completed programs	191	198	216	228
Self-sufficient exploitation ratio (%)	Petroleum/Gas	16.0	15.0	13.0	13.0
	Bituminous coal	53.0	50.0	38.0	30.0
	Iron	15.0	28.0	26.0	32.0
	Bronze	6.0	7.0	8.0	8.0
	Zinc	21.2	22.8	20.6	19.9
	Nickel	68.9	63.2	61.8	55.2

► 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) (www.index.go.kr)

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.

► Rounding figures at one decimal place may be slightly different from the source data such as KOSIS.

► Source: Statistics Korea (New Renewable Energy Center) (www.index.go.kr)

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 CO₂ emissions in major countries (kg per PPP \$ of GDP, 2017)

Korea	USA	Japan	Germany	France	UK	China
0.36	0.29	0.27	0.21	0.13	0.14	0.51

► Source: European Commission, Emissions Database for Global Atmospheric Research, 2018

94 R&D budget for energy and environment as a percentage of GBAORD in major countries (%)

	Korea ('17)	USA ('18)	Japan ('18)	Germany ('18)	France ('17)	UK ('17)
Environment	2.8	0.4	4.1	2.8	1.7	2.4
Energy	6.3	2.7	12.4	5.0	12.7	2.9
Environment and Energy	9.1	3.1	16.5	7.8	10.4	5.4

► Source: OECD, Research and Development Statistics, 2019 (stats.oecd.org)

13. Space**95** Space programs as a percentage of civil GBAORD in major countries

	Korea ('17)	USA ('18)	Japan ('18)	Germany ('18)	France ('18)	UK ('17)
Civil GBAORD for space programs (million USD)	453	9,735	1,727	1,794	2,131	187
Space programs as a percentage of GBAORD (%)	3.1	13.9	5.2	5.0	12.4	1.6

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

► Source: OECD, MSTI 2019–1 (stats.oecd.org)

96 BERD performed in aerospace industry in major countries

	Korea ('15)	USA ('16)	Japan ('17)	Germany ('15)	France ('16)	UK ('16)
Aerospace industry R&D expenditure (million USD)	209	26,645	782	1,893	3,156	2,234
Percentage of aerospace industry R&D expenditure in BERD (%)	0.5	7.1	0.6	2.8	8.9	7.4

► Source: OECD, MSTI 2019–1 (stats.oecd.org)

14. Biotechnology**97** R&D expenditure in biotechnology by company in major countries

	Korea ('15)	USA ('16)	Germany ('17)	France ('16)
R&D expenditure in biotechnology by company (ppp \$)	1,477	44,793	1,433	3,573

► OECD, Key Biotechnology Indicators, October 2018 (<http://oe.cd/kbi>)

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: Ministry of Trade, Industry & Energy, Korea Biotechnology Industry Organization, Report on Survey of Domestic Bioindustry

15. Economic Indicators

99 Population and GDP per capita in major countries (2018)

	Korea	USA	Japan	Germany	France	UK	China (¹⁷)
Population (thousands)	51,655	328,012	126,443	82,902	67,274	66,466	1,390,080
GDP per capita (USD)	31,351	62,480	39,313	48,211	41,287	42,506	8,736

► Source: OECD, MSTI 2019-1 (stats.oecd.org)

100 Labor force, total employment, and value added of industry in major countries (2018)

	Korea	USA	Japan	Germany	France	UK	China (¹⁷)
Labor force (thousands)	27,723	163,503	68,042	43,262	29,860	33,674	806,860 (¹⁷)
Total employment (thousands)	26,646	156,016	68,905	44,491	28,160	32,441	776,400 (¹⁷)
Value added of industry (100 million USD)	11,027	129,967	36,102	25,363	15,859	17,025	99,659 (¹⁸)

► Source: OECD, MSTI 2019-1 (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

100 Main Science & Technology Indicators of Korea

Volume 2019-1

Korean Edition

- Published in August 2019
- Edited and published by
 - Center for Data Analytics Innovation, Office of National R&D Evaluation and Analysis
 - Korea Institute of S&T Evaluation and Planning

Ministry of Science and ICT

- Sung-Chul Kwon sckwon@korea.kr

Researchers

- Yoon-Been Lee yblee@kistep.re.kr
 - Goeun Chung chung0506@kistep.re.kr
-

English Edition

- Published in September 2019
- International Affairs Team
Korea Institute of S&T Evaluation and Planning