

# Korea R&D Status



**Prof. Myung-Cheol Lee**

**Jul. 2017**



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# ***1. R&D Expenditure***

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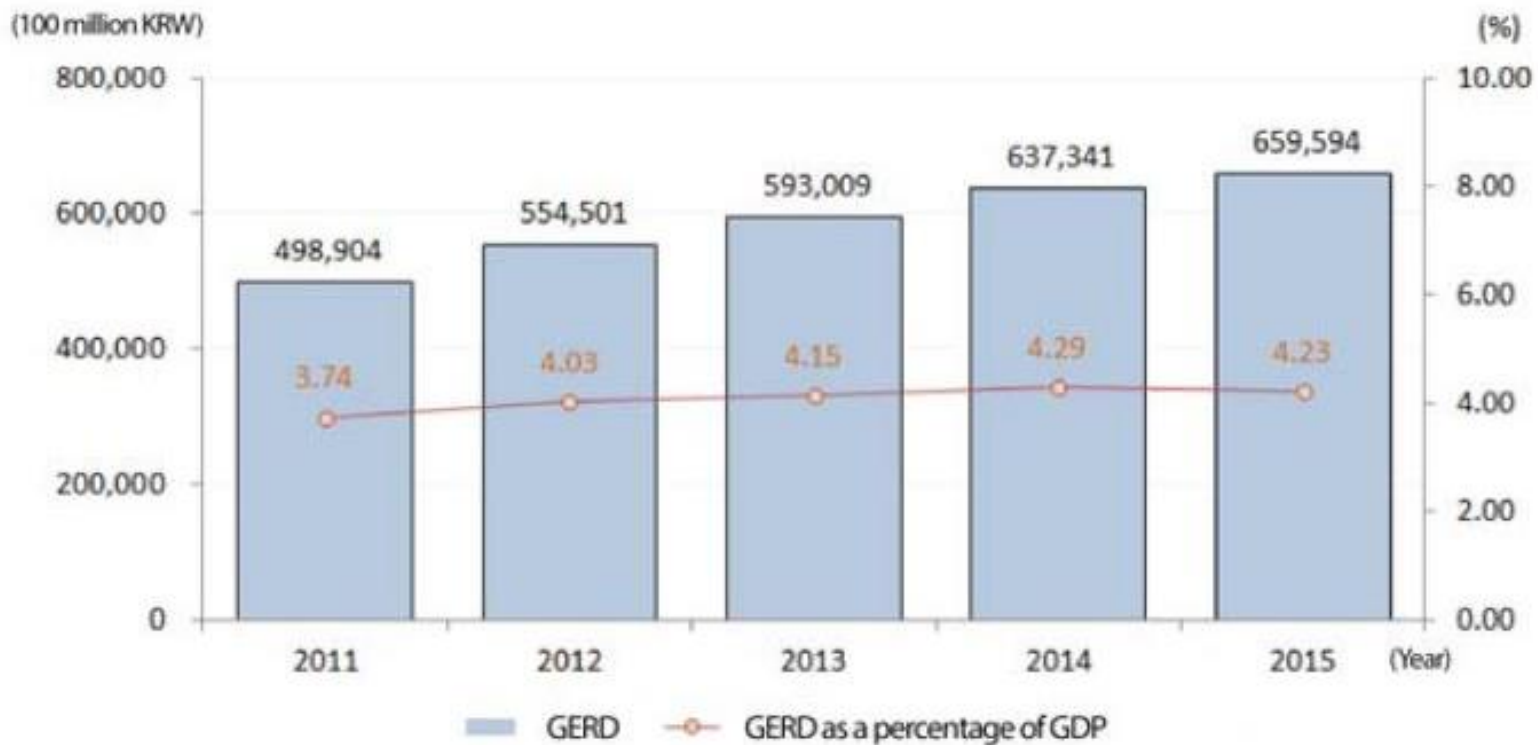


# R&D Expenditure ①



- Korea's Gross Domestic Expenditure on R&D is increasing every year
- The percentage of the GDP is almost 4% above

## Gross domestic Expenditure on R&D (GERD)



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

# R&D Expenditure ②



- The private sector is the biggest source of the GERD fund in Korea
- And the government fund is almost ¼ of the total Korea GERD

## GERD by source of funds in Korea

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

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

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

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

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

▶ Source: OECD, MSTI 2016-1 ([stats.oecd.org](http://stats.oecd.org))

MSIP · KISTEP, Survey of Research and Development in Korea

# R&D Expenditure ③



- The development research is the biggest type of the Korea R&D
- And basic & applied research are almost 20% of the GERD each other

## GERD by type of R&D in Korea

|                      | 2012                         |                   | 2013                         |                   | 2014                         |                   | 2015                         |                   |
|----------------------|------------------------------|-------------------|------------------------------|-------------------|------------------------------|-------------------|------------------------------|-------------------|
|                      | GERD<br>(100 million<br>KRW) | Percentage<br>(%) | GERD<br>(100 million<br>KRW) | Percentage<br>(%) | GERD<br>(100 million<br>KRW) | Percentage<br>(%) | GERD<br>(100 million<br>KRW) | Percentage<br>(%) |
| Basic research       | 101,533                      | 18.3              | 106,658                      | 18.0              | 112,426                      | 17.6              | 113,617                      | 17.2              |
| Applied research     | 105,727                      | 19.1              | 113,159                      | 19.1              | 120,585                      | 18.9              | 137,450                      | 20.8              |
| Development research | 347,242                      | 62.6              | 373,193                      | 62.9              | 404,330                      | 63.4              | 408,528                      | 61.9              |
| Total                | 554,501                      | 100.0             | 593,009                      | 100.0             | 637,341                      | 100.0             | 659,594                      | 100.0             |

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

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

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

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

▶ Source: OECD, Research and Development Statistics, 2016 ([stats.oecd.org](http://stats.oecd.org))

MSIP · KISTEP, Survey of Research and Development in Korea, 2015

# R&D Expenditure ④



- R&D expenditure is focusing on emerging technologies (IT, NT, etc.)
- And investment of the R&D fund to the BT is increasing every year

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

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

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

# R&D Expenditure ⑤



- IT and BT is the main technology that supported by government intramural expenditure on R&D (GOVERD) in Korea
- Especially, the GOVERD to the BT(biotechnology) is more than half of the subtotal amount in that sector

GOVERD (Government intramural expenditure on R&D) by emerging technologies (6T) in Korea

|                             | 2012                           |                   | 2013                           |                   | 2014                           |                   | 2015                           |                   |
|-----------------------------|--------------------------------|-------------------|--------------------------------|-------------------|--------------------------------|-------------------|--------------------------------|-------------------|
|                             | GOVERD<br>(100 million<br>KRW) | Percentage<br>(%) | GOVERD<br>(100 million<br>KRW) | Percentage<br>(%) | GOVERD<br>(100 million<br>KRW) | Percentage<br>(%) | GOVERD<br>(100 million<br>KRW) | Percentage<br>(%) |
| Information Technology (IT) | 28,856                         | 19.7              | 29,742                         | 19.0              | 30,041                         | 18.4              | 33,368                         | 19.0              |
| Biotechnology (BT)          | 27,509                         | 18.7              | 28,770                         | 18.4              | 29,730                         | 18.2              | 33,019                         | 18.8              |
| Nanotechnology (NT)         | 6,436                          | 4.4               | 6,744                          | 4.3               | 7,362                          | 4.5               | 7,965                          | 4.5               |
| Space Technology (ST)       | 6,553                          | 4.5               | 7,354                          | 4.7               | 7,744                          | 4.7               | 10,605                         | 6.1               |
| Environment Technology (ET) | 23,455                         | 16.0              | 24,163                         | 15.5              | 24,577                         | 15.1              | 23,928                         | 13.7              |
| Culture Technology (CT)     | 1,411                          | 1.0               | 1,498                          | 1.0               | 1,542                          | 0.9               | 1,758                          | 1.0               |
| Others                      | 52,576                         | 35.8              | 57,932                         | 37.1              | 62,151                         | 38.1              | 64,557                         | 36.8              |
| Total                       | 146,795                        | 100.0             | 156,204                        | 100.0             | 163,147                        | 100               | 175,199                        | 100.0             |

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

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



## 2. R&D Personnel

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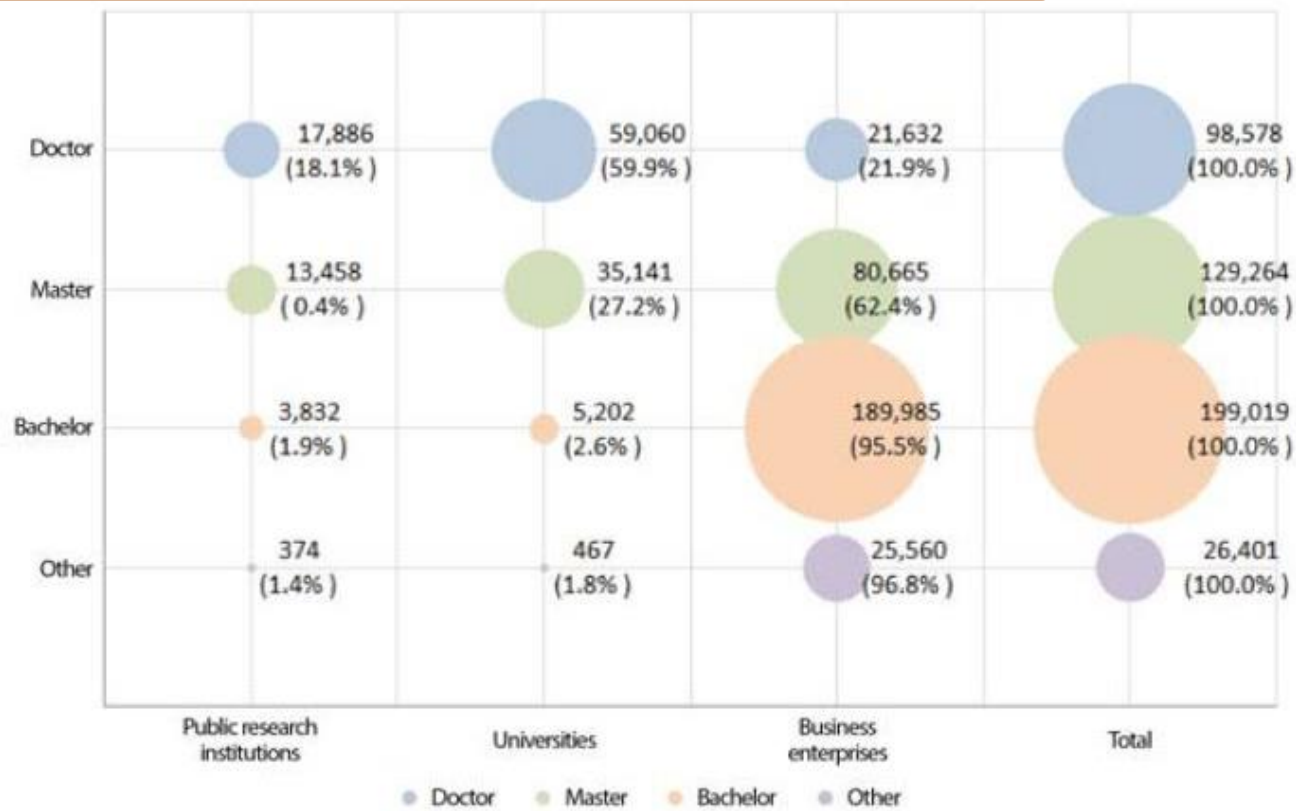


# R&D Personnel ①



- Human resource is the most important resource of the R&D activity
- Korea has many researchers in the public & private sectors

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



▶ Source: MSIP · KISTEP, Survey of Research and Development in Korea, 2015

# R&D Personnel ②



- But, the researchers are biased to the field of engineering
- So, medicine & health field need more researchers to study

## Researchers by field of study in Korea

|                      | 2012        |                | 2013        |                | 2014        |                | 2015        |                |
|----------------------|-------------|----------------|-------------|----------------|-------------|----------------|-------------|----------------|
|                      | Researchers | Percentage (%) | Researchers | Percentage (%) | Researchers | Percentage (%) | Researchers | Percentage (%) |
| Natural science      | 53,654      | 13.4           | 51,494      | 12.5           | 54,772      | 12.5           | 57,976      | 12.8           |
| Engineering          | 273,839     | 68.2           | 279,388     | 68.1           | 298,436     | 68.2           | 308,230     | 68.0           |
| Medicine & health    | 19,945      | 5.0            | 23,292      | 5.7            | 23,522      | 5.4            | 24,066      | 5.3            |
| Agricultural science | 9,912       | 2.5            | 10,102      | 2.5            | 10,662      | 2.4            | 11,045      | 2.4            |
| Humanities           | 20,413      | 5.1            | 20,834      | 5.1            | 22,870      | 5.2            | 23,996      | 5.3            |
| Social science       | 23,961      | 6.0            | 25,223      | 6.1            | 27,185      | 6.2            | 27,949      | 6.2            |
| Total                | 401,724     | 100.2          | 410,333     | 100.0          | 437,447     | 100.0          | 453,262     | 100.0          |

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

# 3. *R&D Performance*

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# R&D Performance ①



## Number of paper published in SCI journals in major countries

|         |                  | 2012    | 2013    | 2014    | 2015    |
|---------|------------------|---------|---------|---------|---------|
| Korea   | Number of papers | 49,884  | 52,322  | 55,126  | 57,626  |
|         | World share (%)  | 3.63    | 3.60    | 3.69    | 3.78    |
|         | World ranking    | 10      | 12      | 12      | 12      |
| USA     | Number of papers | 379,946 | 393,820 | 399,393 | 399,729 |
|         | World share (%)  | 27.63   | 27.13   | 26.77   | 26.22   |
|         | World ranking    | 1       | 1       | 1       | 1       |
| Japan   | Number of papers | 78,488  | 80,095  | 78,385  | 76,847  |
|         | World share (%)  | 5.71    | 5.52    | 5.25    | 5.04    |
|         | World ranking    | 5       | 5       | 5       | 5       |
| Germany | Number of papers | 100,614 | 104,503 | 105,259 | 107,348 |
|         | World share (%)  | 7.32    | 7.20    | 7.05    | 7.04    |
|         | World ranking    | 4       | 4       | 4       | 4       |
| France  | Number of papers | 70,110  | 73,040  | 72,751  | 73,766  |
|         | World share (%)  | 5.10    | 5.03    | 4.88    | 4.84    |
|         | World ranking    | 6       | 6       | 6       | 6       |
| UK      | Number of papers | 106,102 | 112,580 | 112,371 | 116,633 |
|         | World share (%)  | 7.71    | 7.76    | 7.53    | 7.65    |
|         | World ranking    | 3       | 3       | 3       | 3       |
| China   | Number of papers | 188,323 | 222,224 | 256,203 | 285,642 |
|         | World share (%)  | 13.69   | 15.31   | 17.17   | 18.74   |
|         | World ranking    | 2       | 2       | 2       | 2       |

**The Korea ranks 12<sup>th</sup> of the world by the number of SCI papers**

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

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

# R&D Performance ②



- The Korea ranks 5<sup>th</sup> of the world by the number of patent application filed under the PCT
  - \*The PCT(Patent Cooperation Treaty) patent is worldwide index of the R&D performance
- This result maybe effected by the R&D type portfolio (development: 62%) and the leaned human resource distribution (engineering: 68%)

## Number of patent application filed under the PCT in major countries (2016)

|      | Korea  | USA    | Japan  | Germany | France | UK    | China  |
|------|--------|--------|--------|---------|--------|-------|--------|
| PCT  | 10,994 | 42,139 | 34,203 | 13,467  | 5,602  | 4,062 | 30,658 |
| Rank | 5      | 1      | 2      | 4       | 6      | 7     | 3      |

▶ Source: WIPO, WIPO Statistics Database, 2016.12 ([ipstats.wipo.int](http://ipstats.wipo.int))

## Number of patent applications filed under the PCT in Korea

| 2013   | 2014   | 2015   | 2016   |
|--------|--------|--------|--------|
| 12,381 | 13,119 | 14,564 | 10,994 |

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

▶ Source: WIPO, WIPO Statistics Database, 2016.12 ([ipstats.wipo.int](http://ipstats.wipo.int))

# ***4. Summary & Conclusion***

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# Main Science and Tech. Indicators ①



- Korea's R&D expenditure is not low compare to the other nations
- The researchers are enough to study advanced science & technology

## R&D expenditure and personnel

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

- ▶ The sum of Government · Public: Private · Foreign Ratio in China is less than 100.0%.
- ▶ Germany was excluded since the numbers of total R&D personnel (FTE) are different in R&D Statistics, MSTI 2016–1, OECD.
- ▶ Total R&D expenditure in Korea: 65.9 trillion KRW ('15), Government Expenditure on R&D: 18.9 trillion KRW ('15)



# Main Science and Tech. Indicators ②



- But, the performance is under the expectation concerning the inputs (expenditure & human resources)

## R&D performance

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

# Conclusion

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Money and Human Resource is enough to research & develop

And, we have to find the right direction to put our resources

In addition, cooperation with the other is essential to all of us

This is the reason  
we **come** here  
we **gather** here  
we **meet** here



Thank you for your attention

