

# KOREA

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## 1. Introduction

It is not too much to say that R&D investments in the Asian region began in the 1980s in most cases except for Japan. Beginning with cooperation with advanced countries in scientific technology, such as the U.S. National Science Fund (NSF), R&D cooperation in the Asian region has been made mainly through research fund support institutions.

R&D cooperation has been made through the Japan Society for the Promotion of Science (JSPS) and the Japan Science and Technology Agency (JST) in the case of Japan, through the China Scientific Technology Promotion Fund in the case of China, through the Indian National Science Academy (INSA) in the case of India, and through the Australian Research Council (ARC) in the case of Australia.

R&D cooperation in Asia began in the 1980s insignificantly and active cooperation among three countries, mainly Korea, China, and Japan, began in the 1990s. Accordingly, total research funds by country have been steadily increasing in Korea and China.

Beginning with cooperation between Korea and Japan out of the three countries, mainly Korea, China, and Japan, cooperation has been expanded to include cooperation between Korea-China, Korea-India, and Korea-Australia in order of precedence. The forms of cooperation in the early stage were mainly international joint researches with research funds amounting to

approximately KRW 20 million per task, international joint seminars with research funds amounting to approximately KRW 10 million per task, and scientist exchange projects with research funds amounting to approximately KRW 5 million per task.

Cooperation with Japan was made centering on Korea-Japan Basic Science Exchange Committee that began exchanges in 1990 based on the memorandum of cooperation exchanged between KOSEF and JSPS in April 1979. Thereafter, Korea-China Basic Science Exchange Committee was established in May 1995 and cooperation projects have been implemented centering on the basic science exchange committee.

## 2. Cooperation in the Asian Region: Began Centering on Korea, China, and Japan

Cooperation between Korea-Japan and Korea-China cooperation has been made evenly in all areas of scientific technology excluding humanities and social science. In particular, mainly basic science projects have been selected and supported. For example, cooperation with Japan has been mainly made in the area of cutting-edge scientific technologies, such as electricity and electronics, material engineering, and biotechnology centering on Korean scientists who studied in Japan.

Some of the Korea-Japan cooperation projects include doctorate thesis programs, international joint researches, international joint seminars, scientist exchange programs, JSP FelloJapanship Program, Winter Institute Program, among others. Currently, cooperation projects, such as international joint researches and international joint seminars are progressing actively.

Whereas international cooperation between USA and Japan was the most active in the 1980s, countries of cooperation began to be diversified in the 2000s to include Germany, Sweden, and China and cooperation with European countries was expanded and reinforced. In addition, special cooperation projects were made between Korea and Germany, Korea and Sweden, Korea and USA, Korea and China, and Korea and Japan. Here,

**Table 1** Present states of total research funds by country  
(unit: USD)

Country	2006	2007	2008	2009	2010	2011
USA	353,328	380,088	406,258	405,072	408,657	415,193
EU	253,885	270,904	294,208	298,421	305,834	320,456
Germany	70,108	74,016	81,971	82,361	86,280	93,055
Russia	22,856	26,554	30,058	34,158	33,425	35,045
Korea	35,293	40,723	43,906	46,729	52,844	59,890
China	86,619	102,323	120,743	154,025	178,168	208,172

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**Table 2** Present states of R&D funds to the GDP by country  
(unit: %)

Country	2006	2007	2008	2009	2010	2011
Israel	4.51	4.86	4.77	4.49	4.34	4.38
Finland	3.48	3.47	3.70	3.94	3.90	3.78
Sweden	3.68	3.40	3.70	3.60	3.39	3.37
Germany	2.54	2.53	2.69	2.82	2.80	2.88
USA	2.65	2.72	2.86	2.91	2.83	2.77
Korea	3.01	3.21	3.36	3.56	3.74	4.03
China	1.39	1.40	1.47	1.70	1.76	1.84

the two countries jointly invested a certain amount of money to implement cooperation.

The ratios of R&D funds to the GDP of Korea and China have been steadily increasing as much as those of advanced countries in the Americas and Europe. The ratio began to steadily increase from 3% in the case of Korea and 1% in the case of China.

### *2.1 Implementation of Cooperation Projects Through the Basic Science Exchange Committee*

In the early 1990s, cooperation with China was mainly implemented through projects for developing countries, such as training Chinese scientists in Korea, visiting projects including scientific technician exchanges, and training Chinese graduate school students in Korea. Based on such cooperation, international joint research cooperation began in the areas that are the common interests of Korea-China, such as the environment, ocean, among others.

Cooperation with China was centered on natural science and basic areas at the beginning but has gradually included the areas of cutting-edge science, such as electricity/electronics, life science, among others, and the scale of projects has been evolving from simple visiting research and international joint research to large multidisciplinary international joint research. China has been recently asking to prepare large research funds that fit its economic development and enlarge cooperation between China and Korea but mainly medium/small-sized tasks are supported until now because of budget situations in Korea.

In particular, unlike other countries in the Americas or Europe, in the case of Japan and China, considering

the importance of meetings, which is highly relevant in the Asian region, tasks were selected and supported through Korea-Japan and Korea-China's basic science exchange committees. Each country temporarily selected tasks in the country and final tasks were selected through coordination of opinions in meetings held once a year. Each basic science exchange committee was mainly composed of 7–8 university professors who represented academic fields.

Although many cooperation projects with Japan have been implemented through the basic science exchange committee thus far, the two countries agreed to abolish the basic science exchange committee in 2012. Therefore, no basic science exchange committee with Japan exists now and cooperation is implemented with the China Natural Fund Committee only.

As for the cooperation with Japan, in addition to joint research and joint seminars, projects, such as doctorate thesis programs, have been operated. Currently, 20 joint research tasks and 10 joint seminars are supported every year for the cooperation with Japan and the largest number of international cooperation projects are implemented with Japan along with Germany, USA, France, Sweden, and China.

Doctorate thesis programs are those in which Korean graduate school students are registered in schools in Japan and the students make contact with Japanese thesis directors during vacations to submit theses and receive doctorate diplomas. Because Korean students studying in Japan have increased, new tasks will not be selected anymore from 2014 when five currently supported tasks will be completed.

## **3. Present State of International Cooperation Implemented Among Korea, China, and Japan**

### *3.1 Present State of Cooperation between Korea National Research Fund (NRF)-Japan Society for the Promotion of Science (JSPS)*

For the cooperation with Japan in the 1990s, the early stage of cooperation was mostly centered with Korean scientists' visiting research in Japan based on the principle of mutual support for research expenses

**Table 3** Present states of cooperation by country

Year \ Project name	-99	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Cooperative research(new)	140	32	32	32	32	36	36	30	33	31	30	30	21	20	20	555
International joint seminar	79	13	11	13	13	13	13	8	11	11	11	11	10	10	10	237
Scientist exchange	Invitation	229	3	4	4	12	8	9	2	-	-	-	-	-	-	271
	Dispatch	584	29	27	28	34	28	17	14	17	5	5	5	1	-	794
Doctorate thesis(new)	47	4	8	5	4	6	6	6	3	2	2	2	1	-	-	96
Core University Program	3	1	1	-	1	1	-	-	-	-	-	-	-	-	-	7
Asian Core Program	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	2
JSPS Fellowship	-	-	-	-	-	-	10	8	5	1	2	2	6	6	6	46

because many scientists wanted research with Japan given that the country maintained international standards in electronics, life science, and chemistry at that time. Currently, projects at equal footing are mainly implemented, such as international joint research and international joint seminars.

A distinctive project among Japanese projects, which is different from projects of other countries, is JSPS Fellowship in which Japan Society for the Promotion of Science (JSPS) supports all airfares and staying expenses of invited scientists. This project has been selecting 5–6 scientists per year and showing high competition rates until now. Projects with Japan have been implemented through the Korea-Japan Basic Science Exchange Committee established in 1990 but this committee was abolished in 2012.

Cooperation projects have been implemented most diversely and frequently with Japan among countries in the Asian region. However, cooperation with China has been expanded and reinforced since 2007.

### 3.1.1 Introduction of Korea-Japan Basic Science Exchange Committee: Abolished in 2012

Based on an agreement between the governments for basic science promotion in the two countries, mainly Korea and Japan, Korea Science and Engineering Foundation (KOSEF) and Japan Society for the Promotion of Science (JSPS) concluded a memorandum of understanding (MOU) for cooperation in the establishment of the Korea-Japan Basic Science Exchange Committee (1990.12.14.) and the committee was composed of seven branches of study;

mathematics/physics, chemistry/materials, biology, information/mechatronics, the earth/the universe, medicine, humanities, and social science, and has been operated thereafter.

Mainly aiming at adjusting cooperation projects in the area of basic science between Korea and Japan and the discovery of new cooperation projects between the two countries, committee meetings have been held every year during 1990–2012 alternately in Korea and Japan.

### 3.1.2 Overview of the A-HORCs Meeting (Korea, China, and Japan Research Support Institution Head Meeting)

As cooperation among the three countries, mainly Korea, China, and Japan, was reinforced and the necessity of cooperation with each other was required further, Japan Society for the Promotion of Science proposed annual meetings of the heads of research support institutions of individual countries in 2003 to promote cooperation in scientific technology among the three countries. A committee was then organized with the heads of institutions in Korea (Korea Research Fund, NRF), Japan (Japan Society for the Promotion of Science, JSPS), China (National Natural Science Foundation of China, NSFC).

This committee aims to explain the contents and direction of the implementation of cooperation projects of research support institutions in Korea, China, and Japan and to share the results through subject presentations every year. It has been supporting tasks for constructing networks among researchers, such as

**Table 4** The history of A-HORCS meeting

Division	Date held	Subject of presentation	Place
1st	2003.11.05 07	Policy for Science and Technology in Korea	Tokyo, Japan
2nd	2004.12.02 04	Policy for S&T Human Resource Development in each of the Three Countries	Shanghai, China
3rd	2005.11.21 24	Project Evaluation System	Gyeongju, Korea
4th	2006.11.06 09	KOSEF's Role in Korea's S&T	Beppu, Fukuoka, Japan
5th	2007.11.04 08	Measures for Efficient Korea/China/Japan Research Fund Management	Hainan, China
6th	2008.11.05 08	Recent Changes of S&T Policy	Jeju, Korea
7th	2009.11.05 07	Policies on International Cooperation	Hiroshima, Japan
8th	2010.09.15 18	Next 5-year perspective of Research Councils in S&T	Xian, China
9th	2011.09.25 28	S&T Policy for Enhancing Green Innovation	Daejeon, Korea
10th	2012.09.18 20	Policies for Enhancing Basic Research in Korea	Sendai, Japan

※ 11th, 2013.09.26–29, held in Chengdu, China

scientist exchanges and joint seminars, by organizing research teams centering on research-based institutions in the three countries, mainly Korea, Japan and China, through A3 Foresight Program. A-HORCS Meetings has been held 10 times as of now.

### 3.2 Korea Research Fund (NRF)-National Natural Science Foundation of China (NSFC) Cooperation Project

Korea National Research Fund (NRF)-National Natural Science Foundation of China (NSFC) concluded a memorandum of understanding for cooperation in 1992 and have been supporting approximately 12 tasks of cooperative research and international joint seminars every year. On reviewing the records of support by project, it can be seen that the numbers of projects that were small at 5-7 per year until 2000 increased from 2004.

#### 3.2.1 Korea-China Basic Science Exchange Committee

To implement scientific technology cooperation projects in the area of basic science between Korea

and China more systematically to pursue scientific technology development in the two countries and activate basic research exchanges between the two countries, a memorandum of understanding for cooperation in the establishment of the Basic Science Exchange Committee was concluded during a meeting between scientific technology ministers of the two countries ('95.10, Beijing) and the committee meetings have been held every year from October 1995 until now in China and Korea in turn.

Major duties of this committee are the discovery of cooperative tasks between the two countries in the area of basic science, such as drawing areas of scientific technology of joint interests of Korea and China and selection of joint research projects and joint seminars of Korea-China in the area of basic science (unique projects of the research fund). In addition, this committee has been holding Northeast Asian symposiums with participation of the three countries, mainly Korea, China, and Japan.

The Korea-China Basic Science Exchange Committee has been operated with seven members selected from seven areas; mathematics/physics, chemistry, life science, material science, information

**Table 5** NSF-NSFC cooperation records by project

Division	'92 - '99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	Total
Cooperative research	27	7	5	5	15	25	27	25	24	25	25	19	21	22	22	294
Joint seminar	50	9	13	12	13	8	12	14	14	12	13	11	12	10	10	213

science, the earth/the universe, and management science.

### 3.3 Present States of Asian HORCS (Asian Heads of Research Councils)

#### 3.3.1 Background of Establishment and Role

Because scientific technology R&D cooperation was implemented centering on Korea, China, and Japan during 1980–2000, this council was established for annual meetings of the heads of research support institutions of 10 countries from 2007 in order to promote scientific technology cooperation among research support institutions referring to cooperation among Korea, China, and Japan. The participating institutions include all major research fund support institutions in Asia including 10 institutions, mainly the Korea National Research Fund (NRF), Japan Society for the Promotion of Science (JSPS), National Natural Science Foundation of China (NSFC), Indonesian Institute of Sciences (LIPI), National Research Council of Thailand (NRCT), Vietnam Academy of Scientific Technology (VAST), Department of Science and Technology of Philippines (DOST), University of Malaysia (VCC), India Department of Scientific Technology (DST), and Singapore Agency for Scientific Technology and Research (ASTAR). The record of meetings held thus far is as follows:

#### 3.4 Japan Society for the Promotion of Science (JSPS)

##### 3.4.1 Nature of the Institution

This is an institution that forms scientific research

funds for Japanese scientific research foundations, pays funds for researcher cultivation, promotes international exchanges for science, and implements other projects for science promotion, which is an independent administrative corporation under the umbrella of the Japan Ministry of Education, Culture, Sports, Science, and Technology. As of 2012, the budget of this institution is approximately JPY 323.4 billion and the number of personnel is approximately 140.

##### 3.4.2 Major Projects

International academic exchange-related projects implemented by this institution include two country exchange projects, joint research and seminar, researcher exchanges, Asia academic seminars, international chemistry research cooperation project (ICC program), international joint research education partnership program (PIRE program), multilateral international research cooperation project (G8 Research Councils Initiative), A3 Foresight Program, and international academic support. Scientific research fund formation projects include specially implemented research, new rising research, base research, challenge research, research activity start support, among others.

In addition, this institution implements cutting-edge research and development support program (FIRST program), state-of-the-art and next-generation research and development support program (NEXT program), state-of-the-art research base project, special researcher project/overseas special researcher project, global COE (Center Of Excellence) program, among others.

Major projects of the institution include fostering of young researchers, international science cooperation promotion, science research fund support, support for

**Table 6** The history of Asian HORCS

Year	Place	Subject
2008	Tokyo, Japan	Recent Changes in S&T System and New Policy Initiatives in Korea
2009	Seoul, Korea	Human Resources Development
2010	Kuala Lumpur, Malaysia	National Disaster Management Lessons Learnt & Shared Best Practices
2011	Bangalore, India	Nurturing Centers of Excellence
2012	Beijing, China	Evaluation of Science Funding & Quality of Science
2013	Bali, Indonesia	Strengthening of Policy on Innovation Support System in Asia

science cooperation between the academy and the industry, and information collection and sharing for science research activities. The entire budget of this institution was KRW 3,850 billion as of 2010.

### 3.4.3 Manpower Composition

The personnel consists of officers, 96 staff members in 3 departments, and 116 PMs who are outside staff members in the scientific system research center working as full-time workers or part-time workers (212 in total). Some of the personnel are officials dispatched from the Japan Ministry of Education, Culture, Sports, Science, and Technology and universities who are to go back after a certain period of time.

The scientific system research center consists of 9 branches including humanities and is exclusively in charge of academic assessment. Its organization is composed of 1 chief, 2 vice chiefs, senior program managers, and program managers.

### 3.4.4 Major Projects

This institution implements science research subsidy projects that support for up to five years aiming at the development of creative and pioneering research in all areas and global CEO programs that provide JPY 50–500 million for up to five years. In addition, this institution also implements graduate school education reform programs and other graduate school education reform programs that support students in their doctorate courses.

This institution also implements international exchanges, international joint research, and international joint seminars that support research funds to researchers in other countries in order to form international research team networks with many foreign countries.

## 3.5 National Natural Science Foundation of China (NSFC)

### 3.5.1 Establishment

This institution was established in 1986 as a dedicated basic and applied research support institution

as part of Chinese scientific technology systems based on a proposal by 89 members of Chinese Academy of Science and has been implementing not only support for basic research but also scientific technology manpower cultivation programs and scientific technology-related international cooperation projects.

### 3.5.2 Major Functions

Based on national scientific technology development policies, this institution provides funds to basic research projects and some applied research projects. Main activities are utilized as a support for basic and applied research, setting standards for basic and applied research support projects, research task evaluation / selection / support, policy advice for important issues in national basic and applied research policies, support for specialized science groups designated by the government, adjustment and presentation of directions of scientific technology-related program decisions of the groups, linkage with basic research support institutions in foreign countries, and support for the implementation of international cooperation projects.

### 3.5.3 Organization/Budget/Number of Personnel

The organization consists of seven departments, six divisions, and two offices divided by specialized area. The number of personnel is 188 and the budget was KRW 1,800 billion as of 2010.

### 3.5.4 Area of Support

This institution mainly supports natural science and basic science, such as mathematics/physics, chemistry, life science, earth science, engineering material science, and information science.

### 3.5.5 Research Support Project

The general programs of the institution include leading projects, important projects, and national, excellent, and rising scientist funds that account for at least 50% of the entire budget. There are also youth science fund projects and international cooperation

**Table 7** Present state of budgets of major research fund support institutions

no.	Name of institution	Budget amount	Remark
4	Japan Society for the Promotion of Science (JSPS)	KRW 3,855.9 billion	as of 2010 (JPY 276 billion * KRW 13.97)
5	German Research Association (DFG)	KRW 3,526.5 billion	as of 2010 (EUR 2,327.2 million * KRW 1,515.37)
6	Korea National Research Fund (NRF)	KRW 3,364 billion	as of 2011
7	National Natural Science Foundation of China (NSFC)	KRW 1,794 billion	as of 2010 (RMB 10,400 million * KRW 172.5)
8	Japan Scientific Technology Agency (JST)	KRW 1,560.6 billion	as of 2010 (JPY 111,712 million * KRW 13.97)
13	Australia Research Council (ARC)	KRW 864.7 billion	as of 2010 (AUD 743.226 million * KRW 1,163.44)

programs in addition to general programs.

### 3.6 Present state of budgets of major research fund support institutions

The budgets of Japan Society for the Promotion of Science and Korea National Natural Research Fund are similarly exceeding KRW 3,000 billion but the budget of National Natural Science Foundation of China is still around 1/2 of that of Korea or Japan

although it has been increasing sharply recently. Other countries, such as Thailand, Vietnam, and India, are much inferior compared to Korea, China, and Japan in the area of research fund support.

Because of the active international R&D cooperation among Korea, China, and Japan over the last 20 years and steady increases in the amounts of R&D funds, IMD national competitiveness and the rankings of paper publishing by country are similar.

**Table 8** IMD national scientific technology competitiveness rankings (2008–2012)

(Unit: ranking, %)

Country	National competitiveness					Science competitiveness					Technology competitiveness				
	08	09	10	11	12	08	09	10	11	12	08	09	10	11	12
USA	1	1	3	1	2	1	1	1	1	1	1	1	1	2	2
Japan	22	17	27	26	27	2	2	2	2	2	16	16	23	26	24
Korea	31	27	23	22	22	5	3	4	5	5	14	14	18	14	14
Germany	16	13	16	10	9	3	4	3	3	3	6	7	16	13	13
France	25	28	24	29	29	12	11	15	15	12	19	20	20	21	18
China	17	20	18	19	23	10	6	10	10	8	32	21	22	20	26

Source: Swiss International Management Development Agency (IMD), World Competitiveness Yearbook 2012

**Table 9** Present state of paper publication of top ten countries in the number of papers (2009–2010)

(unit : case, %)

Country	2009			2010			Increase/decrease rate of the number of papers (compared to the previous year)
	Number of papers published	Ranking	Global share ratios	Number of papers published	Ranking	Global share ratios	
USA	341,104	1	22.38%	338,784	1	22.17%	-0.68%
China	127,669	2	8.38%	135,375	2	8.86%	6.04%
UK	92,558	3	6.07%	93,092	3	6.09%	0.58%
Germany	89,503	4	5.87%	88,420	4	5.79%	-1.21%
Japan	78,873	5	5.17%	72,882	5	4.77%	-7.60%
India	40,254	10	2.64%	40,688	10	2.68%	1.62%
Korea	38,647	11	2.54%	39,843	11	2.61%	3.09%

#### 4. Conclusion

International cooperation that began among Korea, China, and Japan in the 1980s has been expanded to include 10 Asian countries since the middle of the 2000s and the forms of projects have been changed from simple scientist exchanges, joint seminars, and small-scaled international joint research in the early stage to multidisciplinary large international joint research.

The areas of cooperation are also gradually moving from the solution of regional environmental problems in countries in the Asian region and basic research areas, such as life science in the past to cutting edge science areas, such as computer and electricity/electronics.

However, cooperation among the 3 countries, mainly Korea, China, and Japan still accounts for approximately 90% of international cooperation in the area of R&D in Asia and cooperation with Thailand, Vietnam, and Indonesia is in the starting stage now. Cooperation with countries that have been excluded thus far is expected to gradually increase 10 years from now.

Recent trends of cooperation are implementing cooperation projects by forming joint funds of a certain amount between two countries, such as Korea and Germany cooperation program, in which each country invests KRW 60 million every year, the Korea-Sweden joint fund project in which each

country invests KRW 410 million every year, and Korea-USA special cooperation project in which each country invests KRW 450 million every year.

Among Asian countries, there is the Korea and China basic science program and the Korea, China, and Japan exchange cooperation program. Currently, cooperation that has been mainly made among Korea, China, and Japan has gradually expanded to include other countries, such as Vietnam and Thailand.

As with the EU, its framework program is implemented so that European countries can easily implement cooperation. This is because of the enhancement of economic statuses and scientific technology development in countries in the Asian region, such as Korea, China, Japan, and India. In addition, on the strength of the geographical and cultural traditions commonly recognized by countries in the Asian region, cooperation among Asian countries is expected to be reinforced through meetings such as A-HORCs or Asian HORCs.

In addition, if common plans for effective measures to cultivate young scientists and open access to disclose research results are made through discussions among countries in the GRC (Global Research Council), which is a regional meeting of research fund support institutions in Asian countries scheduled in November 2013, barriers between countries will be removed further and cooperation in the Asian region will be expanded and reinforced.