

India-Korea Collaboration in R&D and High-tech Industries

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Global Challenges

Crises of today confined to a single country or region?

The crises of today affect the entire world.

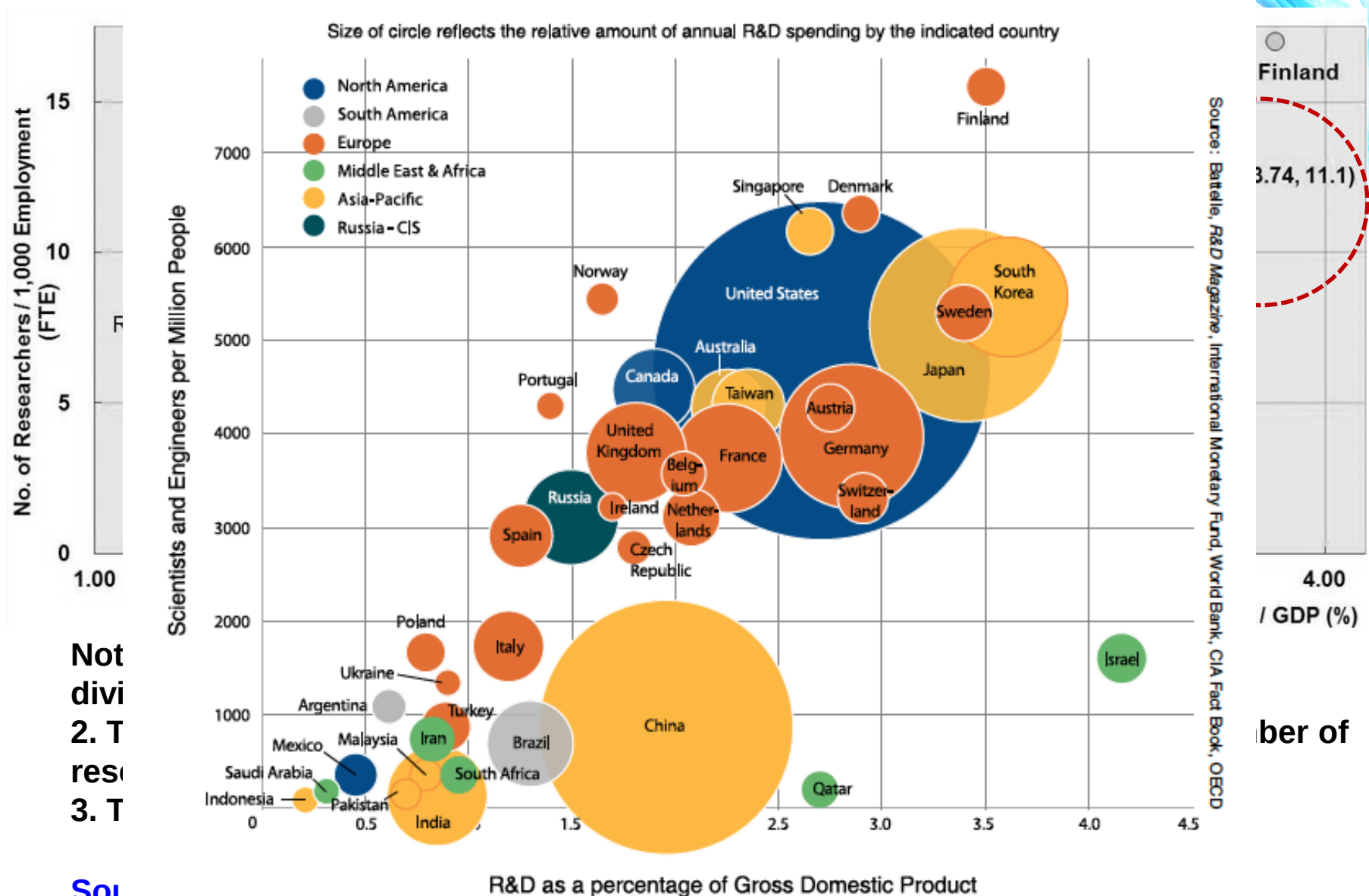
- The entire world must come together as one to address them.
- Countries across the globe are demanding for an institutional system to be able to respond effectively to such global issues.

We need to respond by exchanging ideas and sharing our knowledge.



Source: Korea-ASEAN STI Forum, Korea, 2014

Comparison of the World's R&D Expenditure and Personnel



Global S&T Trends



- Advanced Manufacturing Program(AMP)
 - **Creating 45 New Manufacturing Innovation Institutes Over 10 years** (4 Institutes in this year)
- 5 Nano Signature Initiative
 - Sustainable nano-manufacturing, solar energy collection and conversion, nano-electronics for 2020 and beyond NT, knowledge Infrastructure, NT for sensors and sensors for NT
- EHS Budget Increment
- U.S. Congress ~ \$18.5B (FY 2001 ~ FY 2012) for NT R&D



- Horizon 2020(2014-2020) Program for R&I (~ 80 B€)
 - ✓ Excellent Science, **Industrial Leadership**, Societal Challenges
- NT is on the 'Leadership in Enabling and Industrial Technology(LEIT)' in Industrial Leadership pillar; NT is one of the 6 KETs
 - ✓ NMPB(NT, Materials, Manufacturing, BT) Budget : 4.37 B €
- Drive Policy for Commercialization of Advanced Tech. through the PPP
 - ✓ Factories of the Future, FoF (1b €), Energy Efficient Building (1b €), Green Car (1.2b €)

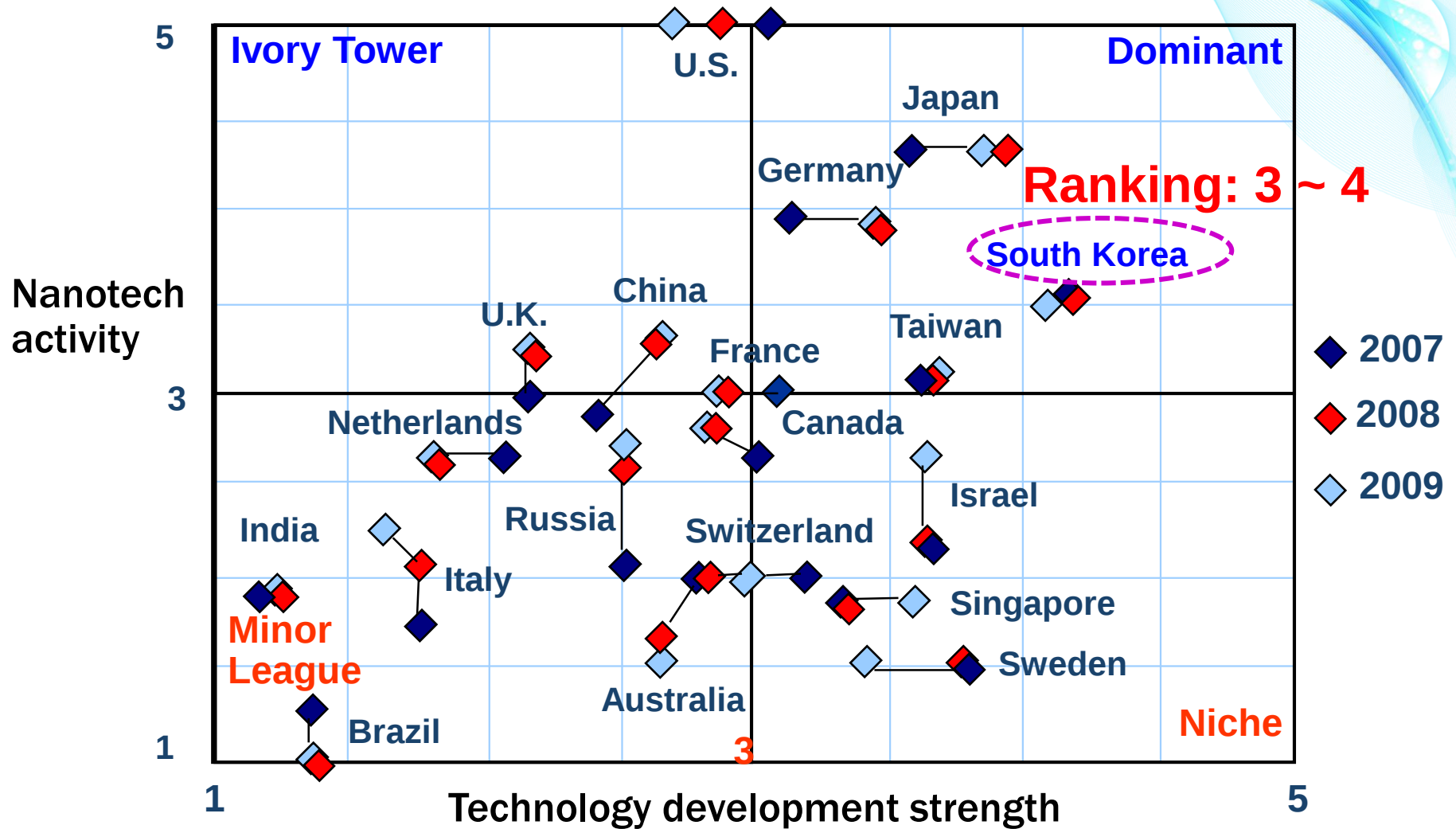


- The 4th Science and Technology Basic Plan (FY2011 to 2015)
 - ✓ Sustainable growth and societal development into the future
 - ✓ 'Science and Technology(ST)' → 'ST , Innovation, and Reconstruction (STIR)'
 - ✓ 'Discipline-oriented' → 'Issue-driven' & 'problem-solving'
 - ✓ Promotion of 'Green Innovation' and 'Life Innovation', etc.
- NT for National Missions: National Defense, Homeland Security, and Space Exploration and **Commercialization**



- NT Research is One of the Top 3 National Core R&D Projects:
 - ✓ **Industrialization** of national advanced technology, national pivotal science research, national basic science research project.
- Categorization and promotion of 'NT Development Roadmap' into 3 Phases:
 - ✓ strengthening of the competitiveness
 - ✓ Paralleled performing
 - ✓ leading the world

Nanotechnology Competitiveness

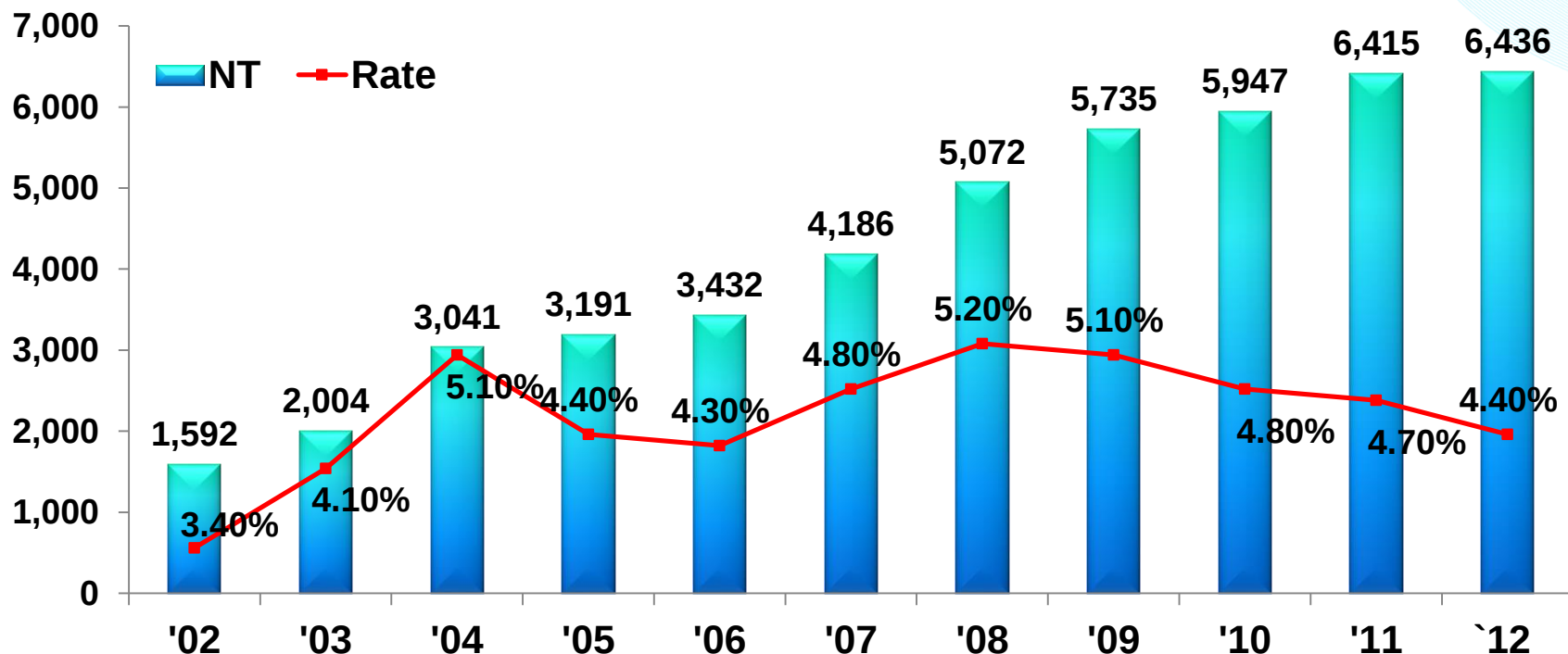


Source: Lux Research Report- Ranking the nations on nanotech, August 2010

Korean Government Funding on NT (2002 – 2012)

Total 4.71 Trillion KRW (4.63% of whole R&D)

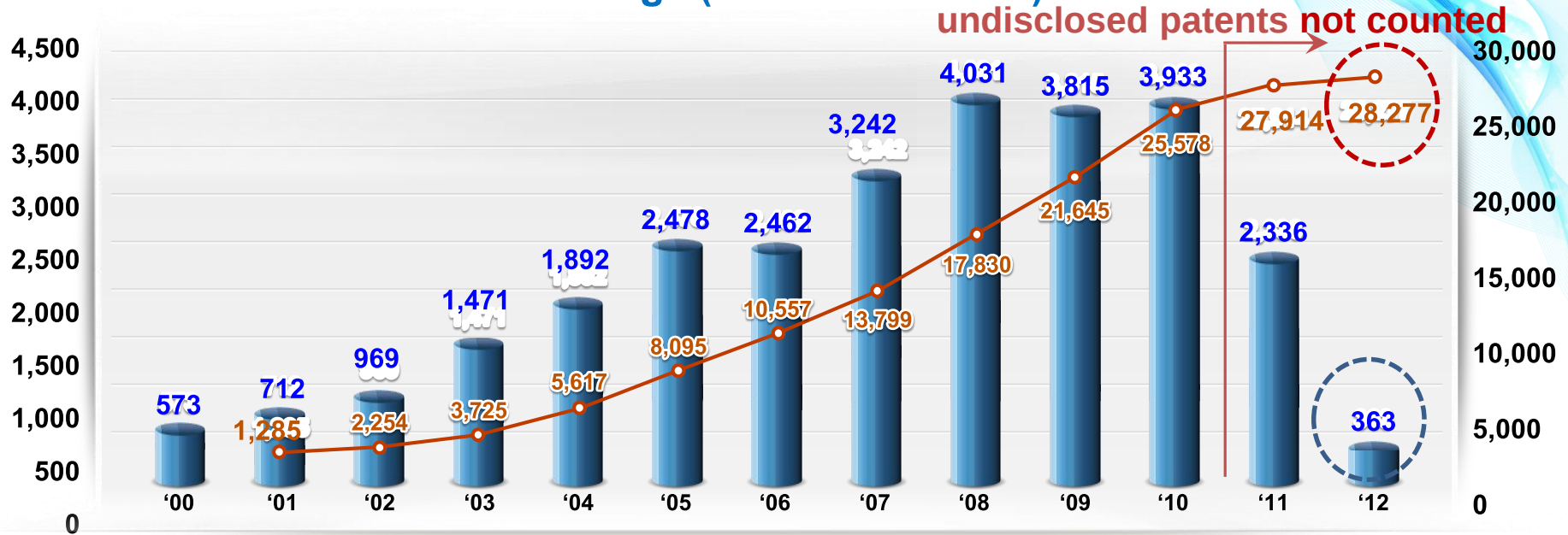
- FY 2013 planned: 5,245 B KRW



Year	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Total	46,984	49,036	59,847	72,218	80,393	87,704	98,363	113,434	124,898	136,107	146,795
NT	1,592	2,004	3,041	3,191	3,432	4,186	5,072	5,735	5,947	6,415	6,436
Rate	3.40%	4.10%	5.10%	4.40%	4.30%	4.80%	5.20%	5.10%	4.80%	4.70%	4.40%

Nanotechnology Related Patents

Number of Patent Filings (Korean IP Office)



Year	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of Patent Filings	573	712	969	1,471	1,892	2,478	2,462	3,242	4,031	3,815	3,933	2,336	363
Accumulated Total	-	1,285	2,254	3,725	5,617	8,095	10,557	13,799	17,830	21,645	25,578	27,914	28,277

Number of Patent Filings (US IP Office)

Year	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of Registered Patents	10	26	29	54	73	58	81	100	158	181	333	428	475	494
Ranking	9	6	5	4	4	5	5	4	3	4	3	3	3	3

Source: USPTO Data Base of Wips, January 2014.

Nanotechnology Related Publication

Number of SCI Papers by Korean Researchers



Year	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of Papers	318	569	689	1,020	1,371	1,638	2,092	2,270	2,884	3,210	3,637	4,413	4,913	5,007
Ranking	9	8	8	6	6	6	5	5	5	5	5	3	3	4

In 2013 : China (20,743), US (14,850), India (5,453), **Korea (5,007)**, Germany (4,201), Japan (4,090)

Source: SCIE Data Base of Thomson, February 2014.

30 Future Technologies

Nano
Devices

1

- Nano memory device, nano CMOS logic device, ultra small nano Sensor, nano electronic device, and nano flexible device

Nano
Bio

2

- Nano-based food, nano wellbeing product, nano diagnosis, nano analysis of cell, and intelligent nano medicine

Nano Energy/
Environment

3

- Nanostructured solar cell, secondary battery, fuel cell, membrane, thermo-electrics, and piezo-electric systems

Nanomaterials

4

- Mass production, functional material, printed electronic materials, energy harvesting, nano catalyst / porous media, resource collection, and substitute

Nano Manufacturing
/ Measuring
Devices

5

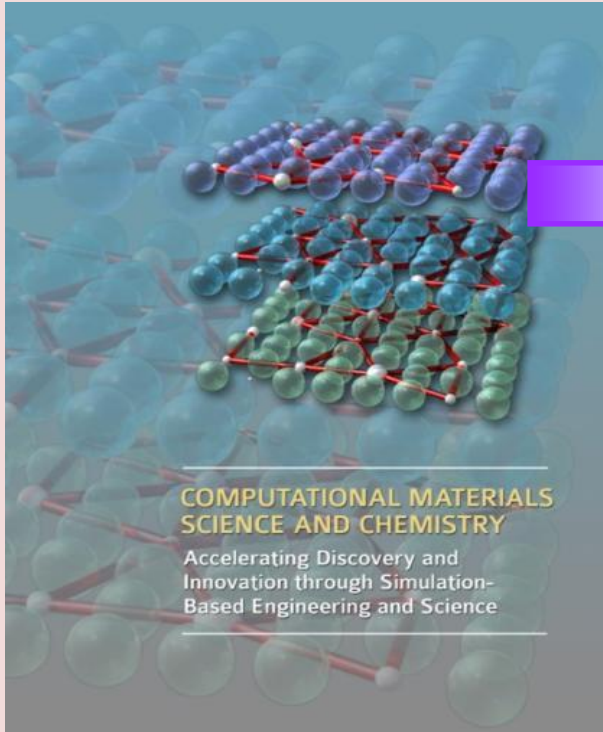
- Large-sized nanomaterial manufacturing, nanostructured patterning, measurement in nano manufacturing, nano thin film manufacturing, simulation, and smart manufacturing



Selected Research Topics

- Creative Materials Discovery Initiative-

Materials and Chemistry by Design Department of Energy



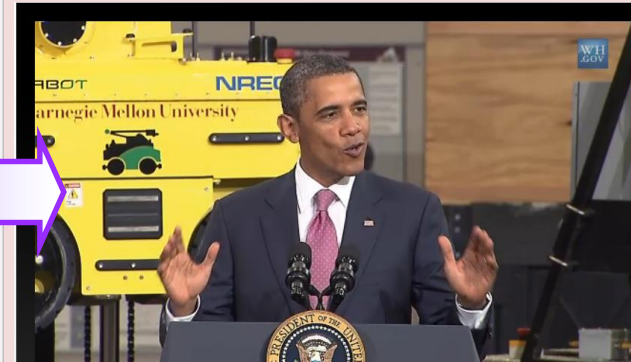
"We are at the threshold of a new era where predictive modeling will transform our **ability to design new materials and chemical processes**, thereby enabling **rational discovery strategies** for systems that were not tractable a few years ago."

Materials Genome Initiative Office of S&T Policy (OSTP)



The Materials Genome Initiative will create a new era of **materials innovation** that will serve as a foundation for strengthening domestic industries ... and offers a unique opportunity for the United States to discover, develop, manufacture, and deploy advanced materials at least **twice as fast as possible today, at a fraction of the cost.**

Advanced Manufacturing Partnership



President Obama kicks off the Advanced Manufacturing Partnership (AMP), a national collaboration between the government, industries, and universities to invest in cutting-edge technologies, create new jobs and bring about a renaissance in American manufacturing. As part of his new AMP, the President is announcing an ambitious plan, the Materials Genome Initiative, to **double the speed with which we discover, develop, and manufacture new materials.**

Vision & Goals of the 3rd Phase Plan

➤ Construction of a leading nation in NT

Goals



The 4th Korea Nanotechnology Initiative

➤ **Planning Period: 2016-2025**

➤ The 4th KNI will be established by the end of 2015.

➤ Planning of KNI is being started by both NNPC and KoNTRS since June, 2015



STEP1

Result assessment of the 3rd phase plan

Especially on the investment effectiveness of NT

STEP2

Analysis and implementation of global environment change

Global environment analysis where Korea is standing

STEP3

Coherence with the government's policies

Support pledges related with NT

STEP4

Support Creative Economy

Creation of the new nano convergence industry for job creation, industrial competitiveness enhancement, and overall social benefit.

STEP5

Expedite commercialization of NT

Facilitation of already developed NT for commercialization, sustaining of the competitiveness of major industries



Korea Infrastructure Organization for Nanotechnology (KION)

KION 국가나노인프라협약체
Korea Infrastructure Organization for Nanotechnology

☐ Purpose and Roles of KION

● Major Activities

- Providing effective support for domestic nanotechnology research and development via close collaboration amongst domestic Nano-infrastructure.

● Role

- Constructing a mutual cooperation system for preemptive response to the nanotechnology paradigm shifts and consumer demands
- Policy development for increased nano-infrastructure efficacy, research support, manpower training, collaboration projects
- Providing and sharing integrated information on attained technology, equipment, service, and usage, etc.
- Mutual PR for nano-infrastructure



Members of KION, National NanoFab Facilities

u-ITC

Ubiquitous
IT Cluster



Songdo
Seoul
Suwon

KPEC

Korea
Printed
Electronics
Center



Daejeon

Jeonbuk

Pohang

NCNE

National
Center for
Nanoprocess
& Equipments



Gwangju

Busan

KANC

Korea
Advanced
Nano Fab
Center



NNFC

National
Nanofab
Center



NCNT

National
Center for
Nanomaterials
Technology





Nano Technology Research Association

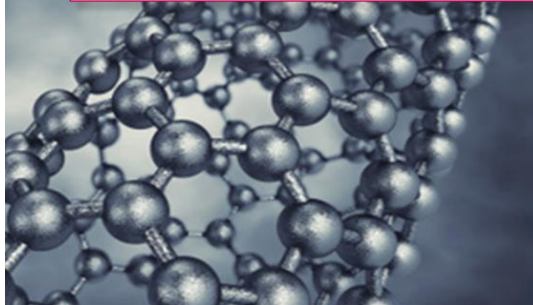
☐ Purpose of Establishment and Mission

- Help private sector for **commercialization of research outcomes in nanotechnology**
- Networking of government, academia, research institutes and private sector

How to boost up fast commercialization of research outcomes in nanotechnology successfully?

“Strengthening industrial competitiveness of existing major industries”

**Convergence Commercialization
of NT and other industry fields**





Nano-Convergence Foundation (NCF)

☐ Background and Vision

- **Delayed/Slow Commercialization of Research Outcomes**
 - Missing links between research steps
 - Poor linkage between research programs
 - No systematic flow of R&D information between related sectors
 - Absence of systems promoting commercialization of research outcomes
- **Creation of new markets & industry through commercialization of nanotechnology**

Commercialization

- ☐ Finding breakthrough technologies
- ☐ Developing core nanotechnology
- ☐ Commercialization of research outcomes
- ☐ Bringing-up nanotechnology corporations including start-ups

Integrated platform

- ☐ Mgt. of overall process of R&D
- ☐ Focusing on big convergence tech.
- ☐ Sharing outcomes/information among sectors of private and public
- ☐ Inducing participation of private sector (VC)

Nano-Convergence Foundation

Routes for Commercialization of Nanotechnology

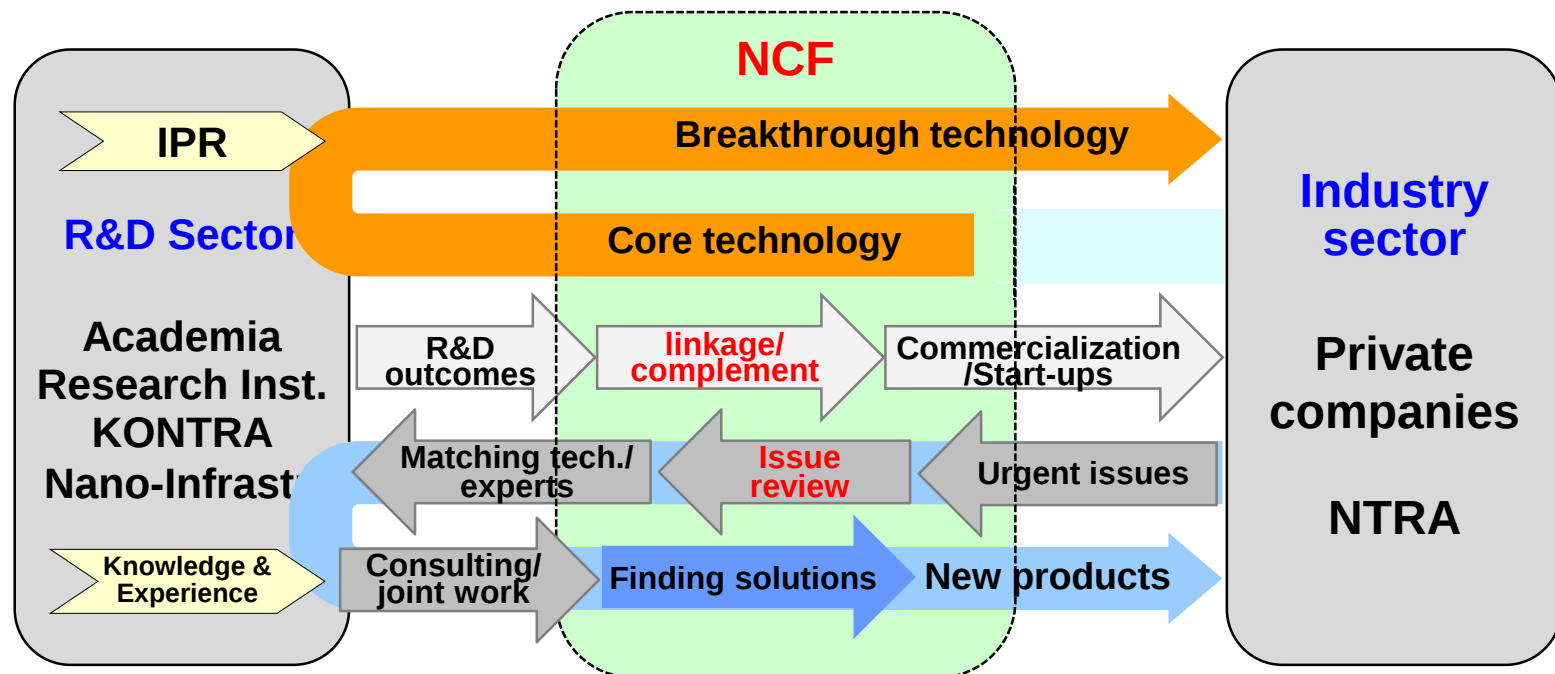
(1) Finding promising breakthrough technologies leading to big industries and financial support for their development (ex. post-CMOS)

(2) Commercialization of research outcomes (linkage and complement)

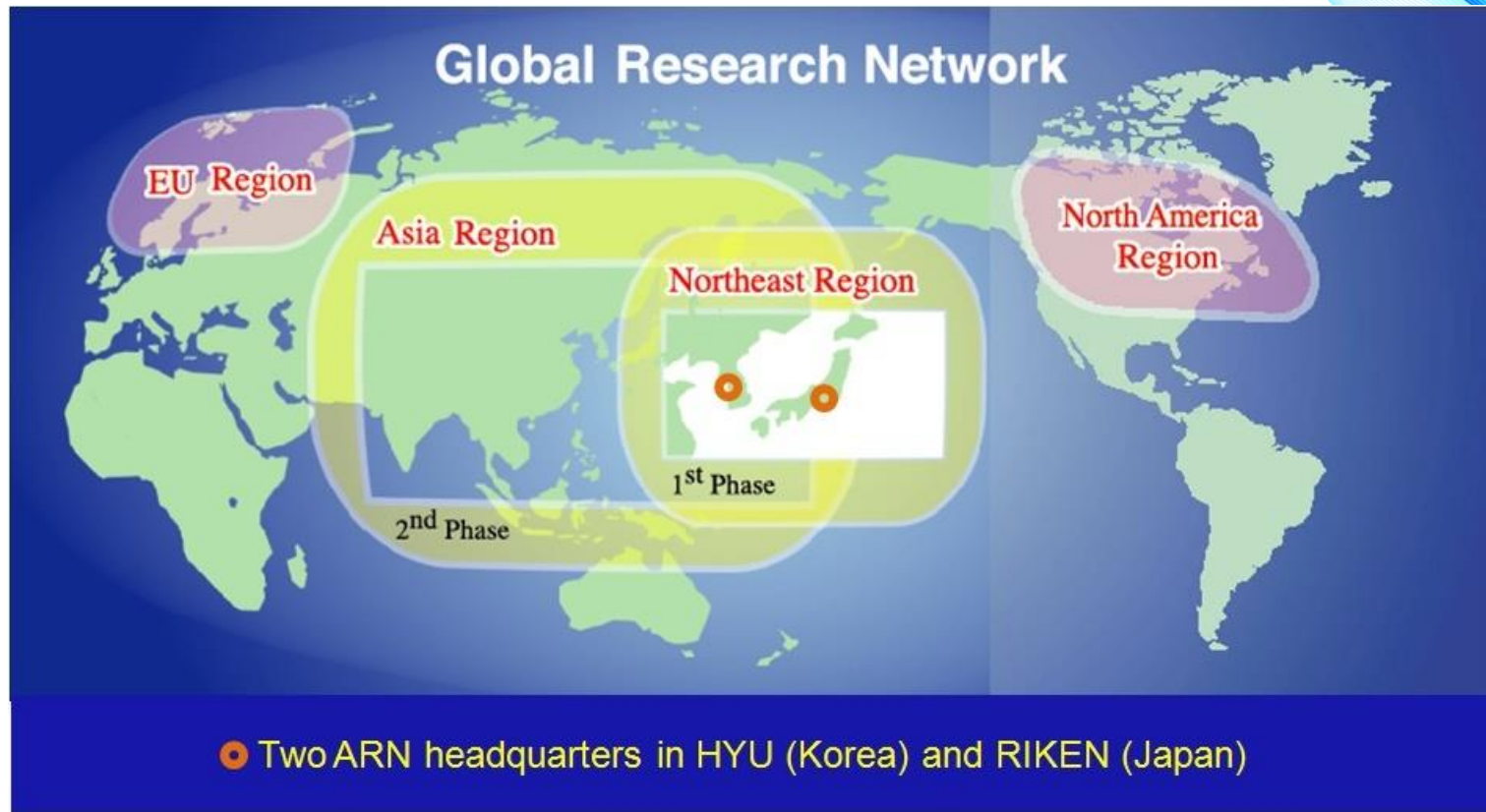
“Needs-matching Commercialization Program”

(3) Provision of solutions for industrial needs (technology-matching & consulting)

“Technology-matching Issue-Solving Program”

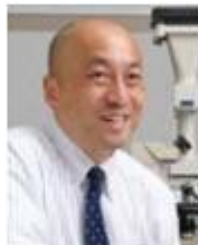


Global Science and Technology Network

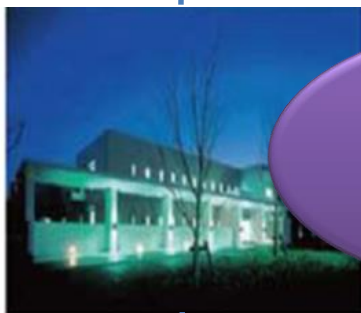


- 1st Phase (Before July 2009):** Participation of 2 countries(Korea and Japan),
7 institutions including HYU and RIKEN
- with **2 Headquarters (HYU, RIKEN)**
- 2nd Phase (After July 2009):** Extension to all Asia
(China, India, Singapore, Korea)
- 3rd Phase (After July 2015):** Extension to global network

IV ARN Asian Research Network Scheme



Masahiko HARA
Co-director



RINKEN Advanced Science (ASI)
Institute
Main Institute at RIKEN in Wako

Japan, China, India, Singapore, Israel,
Saudi Arabia, ASEAN

Excellent Post Drs.
From Asia, US, EU

Excellent Students
Scholarship



Research
Collaboration
Exchange
Program

Establishment of
Asian R&D Culture

Asian Research Network Korea at FTC
HYU, SNU, ETRI, KRICT, IPK, KANC,
NNFC, POSTECH, KONTRS, Park
Systems

USA



HYU Institute of Nano Science &
Technology (INST)

ETRI-Hanyang University Open
R&D Center

RIKEN-Hanyang Collaboration
Center



Haiwon LEE
Co-director

Strategy for Asian Research Network

- Establishment of **strategic Asian R&D network** with a global concept
- Strong collaboration with partnership among of participating institutions
- Promotion of interdisciplinary integrated collaborative research
- **Conducting R&D projects & training talented individuals** for achieving excellence in science
- Secure talented R&D researchers in science & emerging technology convergence areas
- **Excellent top-level education** including pre-internship for graduate students
- Utilization of excellent facilities and knowledge transfer
- Stable government R&D funding and fellowships from both industry & government
- **Creation of borderless, flexible organizational management**
- Promotion of **global frontier leadership** programs
- Development of new initiatives for business models for translation

RIKEN (2008. 4. 10)



U. of Pune, India
(2007. 11. 12)



UT Dallas, USA
(2009. 1. 11)



IV

Asian Research Network (ARN) for Global Networking @ Hanyang University (Seoul)

HQ of ARN Korea



VIPs Visit to ARN

Japan Prime Minister ,
Dr. ASO Taro's Visit to FTC
(2009.01.11)



歡迎 日本首相 麻生太郎 漢陽大-RIKEN 訪問



2013 ARN Summer Camp in Korea (2013.7.24-27)

Place: Hanyang University



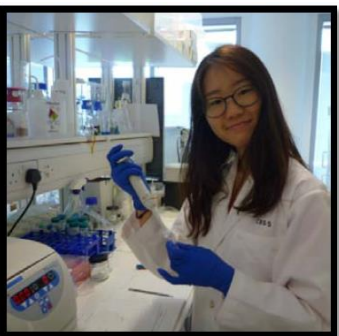
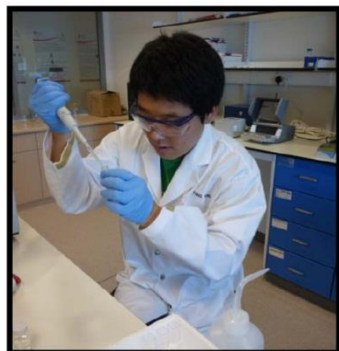
Asian Research Network Summer Camp 2013

Date : Jul 12(Fri.) ~ 14(Sun.), 2013 Venue : Fusion Technology Center 4F 402

Sponsor : Park Systems, Institute of Nano Science and Technology



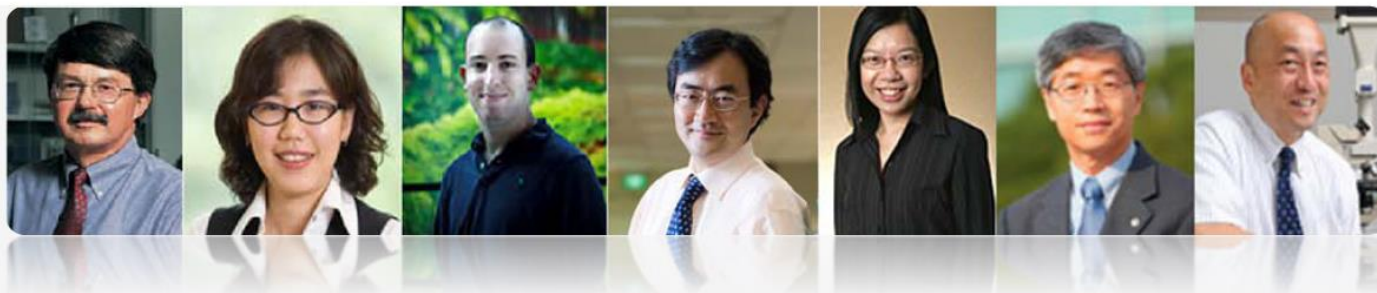
IV Research Experience for Undergraduate (REU) 2012 in Singapore (2012. 6.25-8.3)



REU 2012 PROGRAM PARTICIPANTS

Weekly Seminar Series

Students participated in a number of REU scientific lectures and were able to meet and learn from eminent science leaders.



LECTURE SERIES SPEAKERS: CURTIS W. FRANK, SUENGMIN HAN, JOSH JACKMAN, KIM SHIN CHEUL, LEE POOI SEE, HAIWON LEE, MASAHICO HARA



Asian
Research
Network



NANYANG
TECHNOLOGICAL
UNIVERSITY

Participant:
Hanyang, Sogang,
Ajou, Ehwa,
(Korea),
TIT (Japan),
NTU (Singapore)

Organizer:
2012 : NTU
2013 : TIT
2015 : HYU

V Visits of Indian Institutions

**Director, Indian Institute of Science
Prof. P. BALARAM**



Connectivity between ARN and India

➤ Connectivity between ARN and India

▪ Indo-Korea Human Resource Exchange

-> This program is to make it easy to carry forward science & technology cooperation such as joint R&D projects and technology transfer between bilateral scientists and researchers.

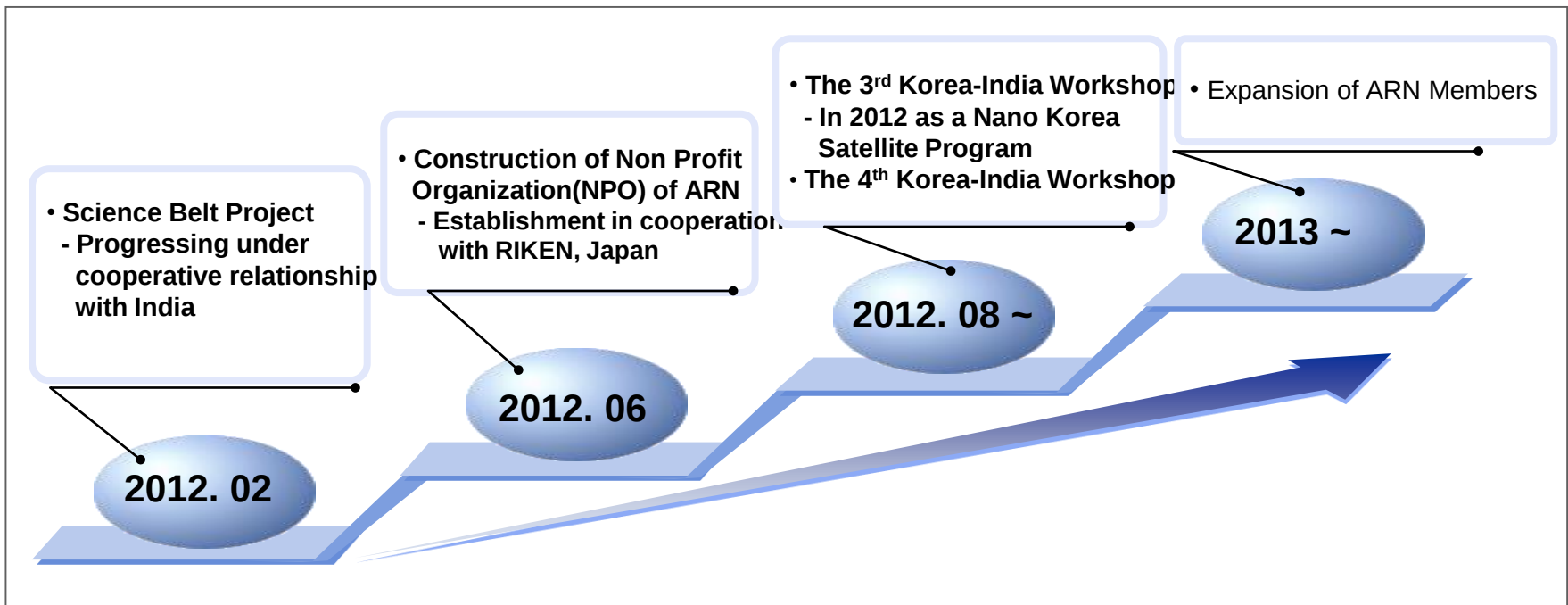
▪ Korea-India Joint Workshop

-> Having started the 1st Korea-India Workshop in August, 2010, joint workshops are scheduled to be held twice a year for 5 years.

▪ Mobile Science Laboratory Program

-> This program is as one of ARN's educational program jointly operated by LG Electronics, Hanyang University, and Pune University(India)

➤ After 2012, Plan forward



The India-Korea Joint Workshop is aimed to improve the relations in Science and Technology between two countries through their mutual interest in various areas. The workshop is not only envisioned to make a win-win model based on the exchange of ideas and human resource but also expected to proceed to India-Korea economic partnership. In view of these expectations, the workshop is considered as a practical approach towards establishing a win-win model for global research network.

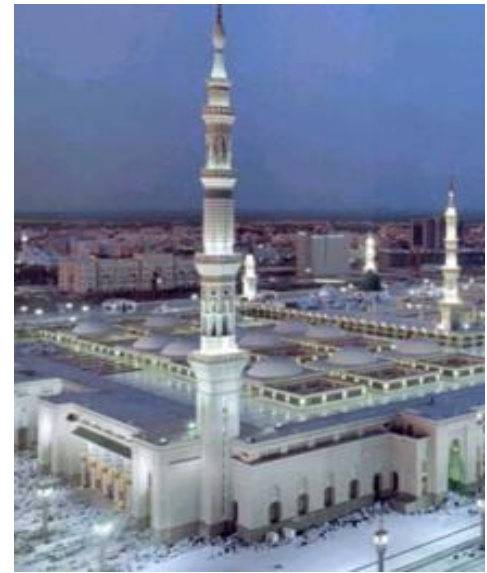
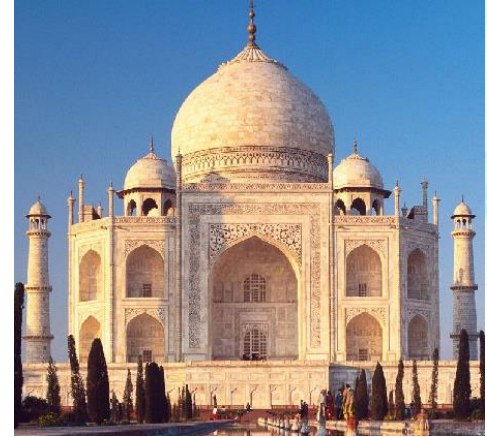
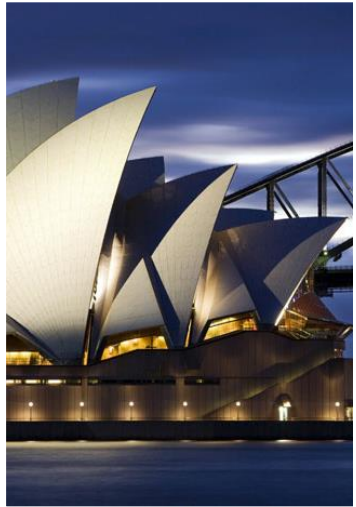
- The 1st IKJW, May 2010, “ Energy and Environment” Lotte Hotel, Seoul
- The 2nd IKJW, November 2011, “Chemistry and Nanomaterials & Nano Conclave” , Vivanta by Taj Hotels and Resorts, Chennai
- The 3rd IKJK, August 2012, “NanoBio and Healthcare”, Coex, Seoul
- The 4th IKJK, December 2012, “Bio/Medical Science & Application”, Lalit Hotel, New Delhi
- The 5th IKJK, September 2013, “Bioenergy”, Trivandrum
- The 6th IKJK, September 2013, “Robotics”, Jeju
- The 7th IKJK, November 2014, “Green Mobility and Energy Materials”, Hyderabad

India-Korea Joint Workshop

[The 2nd India-Korea Joint Workshop & Nanotechnology Conclave on Nov. 3~4, 2011, Chennai, India]



VI Building the Bridge for Global Network



Asian Research Network

www.asianrn.org

the home of Asian Research Network, offers integrative research and education opportunities on outstanding and emerging science and technology

Thank you very much

