

Raison d'être of Globalized Public Research Institutes

YONG-TAEK IM

President

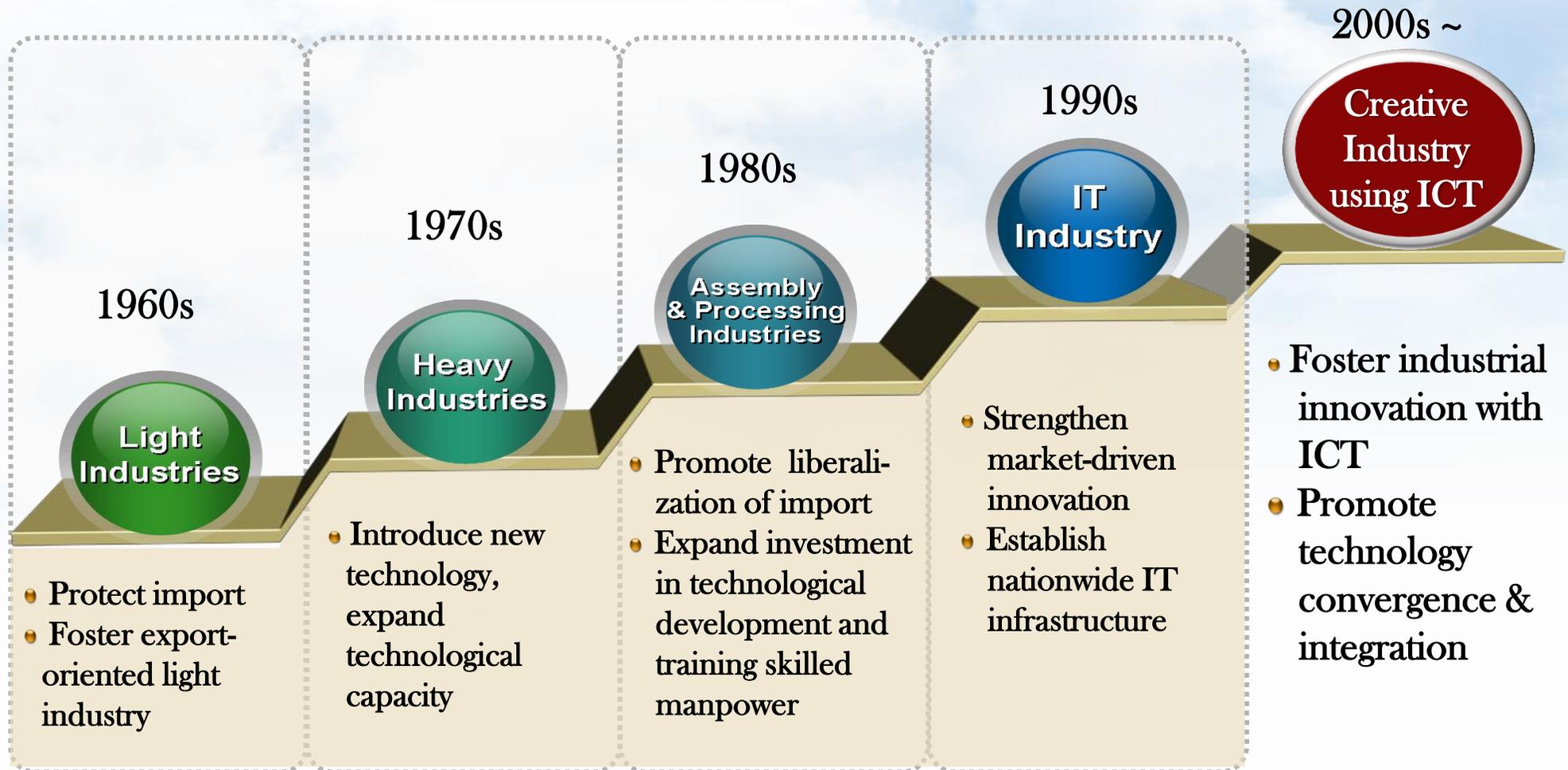
ytim@kimm.re.kr

KIMM 한국기계연구원
KOREA INSTITUTE OF MACHINERY & MATERIALS

National S&T Development Plan:

“Planned Economy:
Fast Follower”

“Creative Economy:
First Mover”



Mission and Goal of KIMM:

Mission:

To contribute to economic growth of the nation by performing R&D on key technologies in machinery and materials, conducting reliability test evaluation, and commercializing the developed products and technologies

Goal:

To become a global research institute in the field of mechanical engineering by introducing a new governance system to foster knowledge, innovation, motivation, and marketability, resulting in improving the research productivity and capability

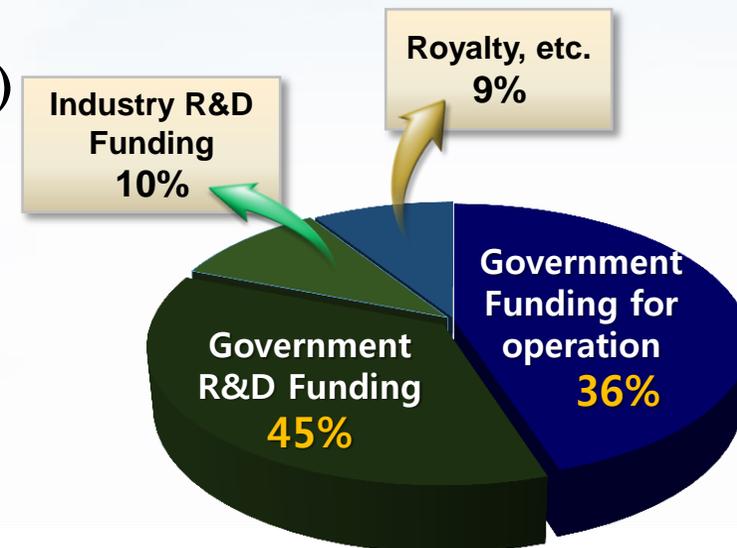
Overview of KIMM:

History:

- 1976, Founded as the Korea Test Institute of Machinery & Metals
- 1996, Spin-off KARI (Aerospace)
- 1999, Spin-off KRISO (Ocean)
- 2007, Affiliated Institute KIMS (Materials)

Personnel & Budget:

- Employee (FT): 366 (Ph.D: 269 (73%), MS: 58 (16%))
- Employee (PT): 179 (Ph.D: 421 (12%), MS: 66 (37%))
- Budget ('15): 165M USD



Advanced Manufacturing Systems:

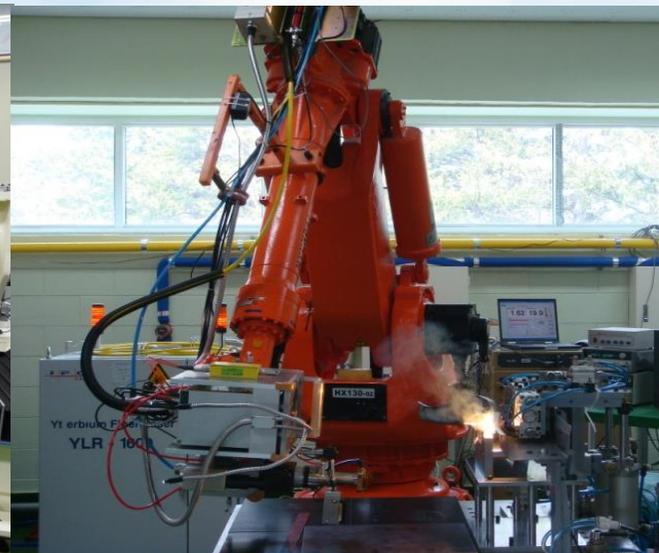
- Ultra-Precision Machines and Systems
- Laser & Electron Beam Application
- Printed Electronics
- Robotics and Mechatronics



Gravure-offset Printed Silver Grating



Precision Pitch Line-Patterning



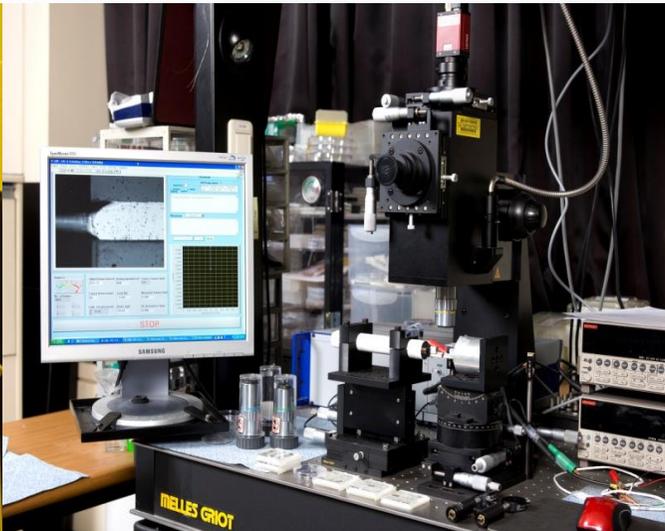
Remote Laser Processing

Nano-Convergence Mechanical Systems:

- Nano Manufacturing Technology
- Nano Mechanics
- Nature-Inspired Nano Convergence System



Nano-imprint Lithography System



Nano-mechanical Testing



Nature-inspired Mechanical System

Environment & Energy Systems:

- Eco-Engineering System
- Internal Combustion Engine
- Plant Safety Engineering
- Reliability Engineering for Nuclear Equipments



Gaseous Fuel Injection System



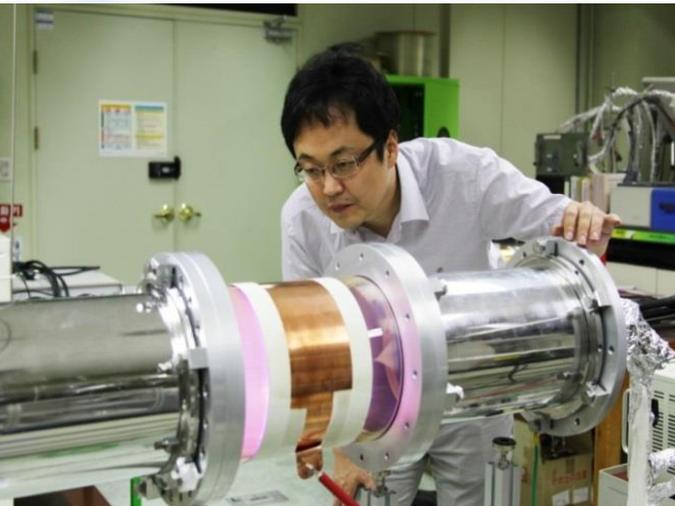
Oxyfuel Combustion Power Plant



Reliability Evaluation for Nuclear Equipment

Extreme Mechanical Systems Engineering:

- Plasma Engineering
- Extreme Energy Systems Engineering
- Extreme Thermal Systems Engineering



Industrial Plasma Tech.



Ground Pilot for Geologic Storage of CO₂



Hydraulic Design Tech. for RCP

Mechanical Systems Safety:

- System Dynamics
- System Reliability
- Magnetic Levitation and Linear Drive



Modeling & Simulation for
Mechanical Systems



Wind Power Accelerator System



Magnetic Levitation Train

Regional R&D Centers:

- Medical Devices and Green Energy (Daegu)
- Laser Technologies (Busan)
- LNG and Cryogenic Technology (Gimhae)



Active/smart robot for upper-limb stroke rehabilitation



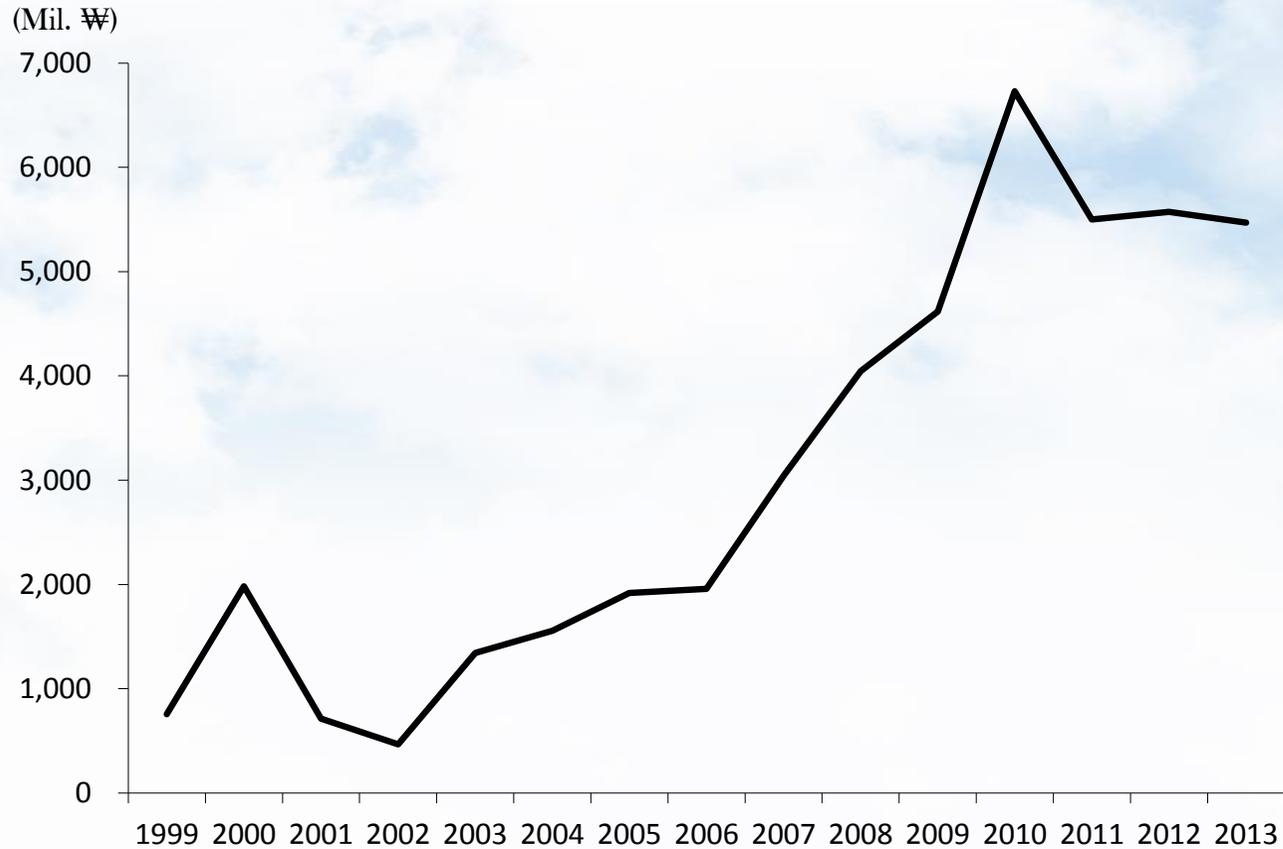
Aerial View & Laser Welding Systems



LNG and Cryogenic Test Facility

Technology Transfer:

License-fees



Spin-off Companies

TEMS Co. Ltd.

DI Tech Co. Ltd

SelfTech Co. Ltd.

NEI Co. Ltd.

JPE Co. Ltd.

Major Accomplishments: EcoBee

World's 2nd Commercialized Urban Maglev:

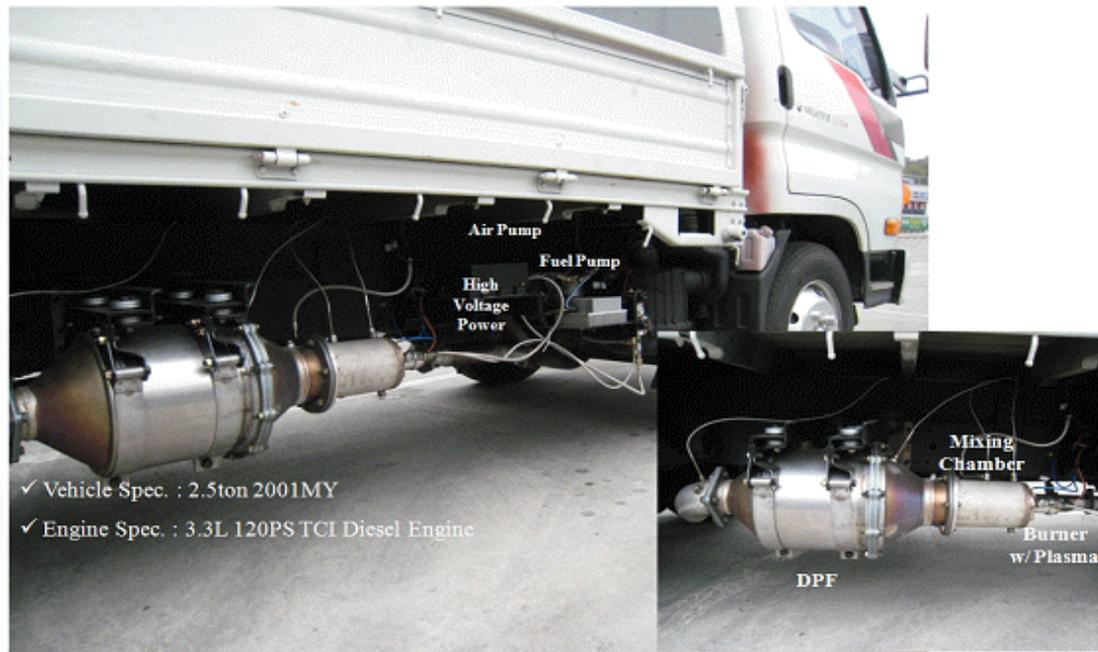
- Commercial Service at the Incheon Int'l Airport (6.1km) to be expected soon
- MOU with Gordon Atlantic Co. for the service in the State of Leningrad in Russia



- Eco-friendliness with low noise, low vibration and no pollutants
- No risk of derailment or electromagnetic hazard
- Low maintenance and operation costs



Plasma Burner and Reactor (continued):

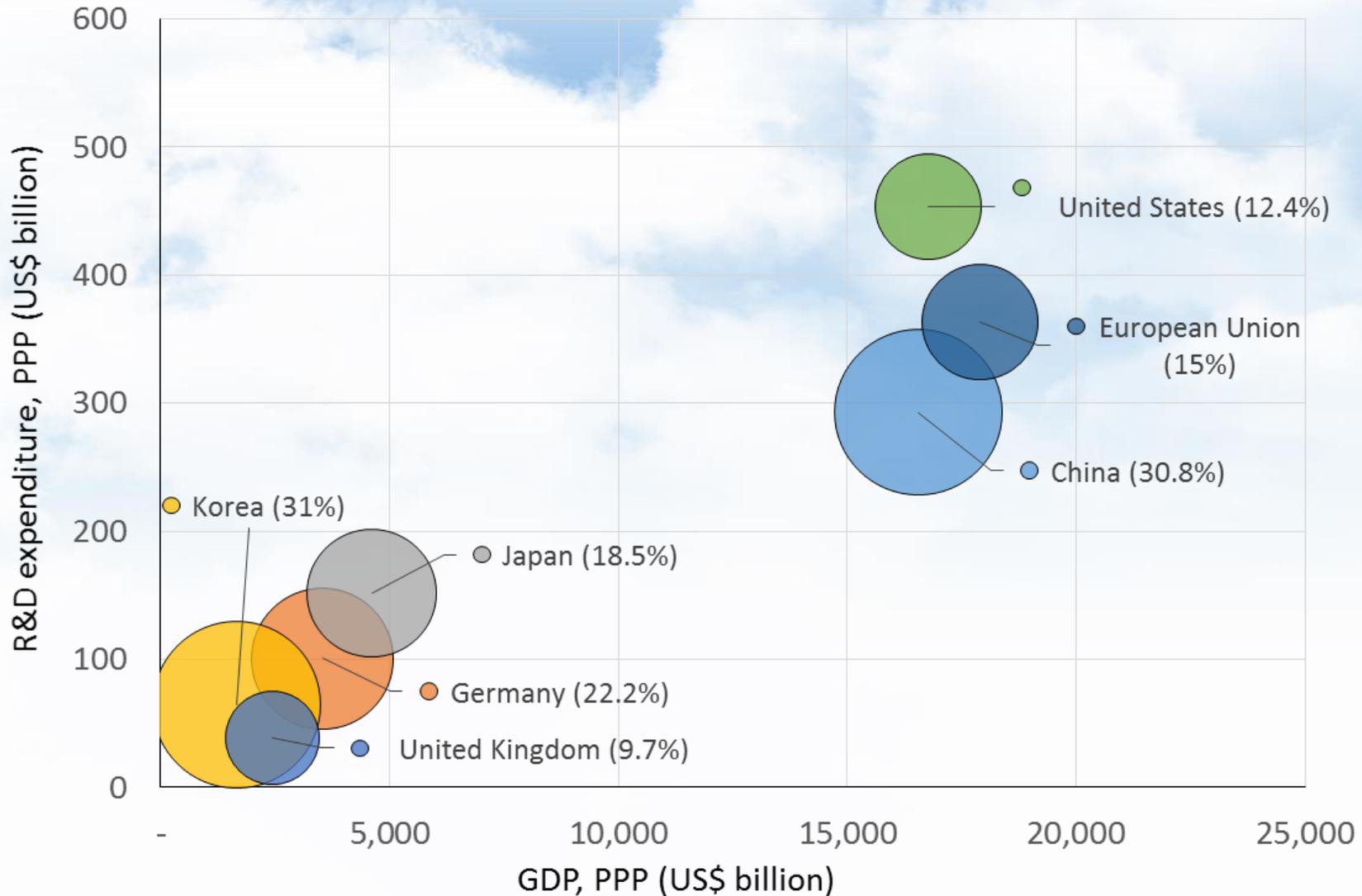


Plasma assisted burner for regenerating DPF (Diesel Particulate Filter)

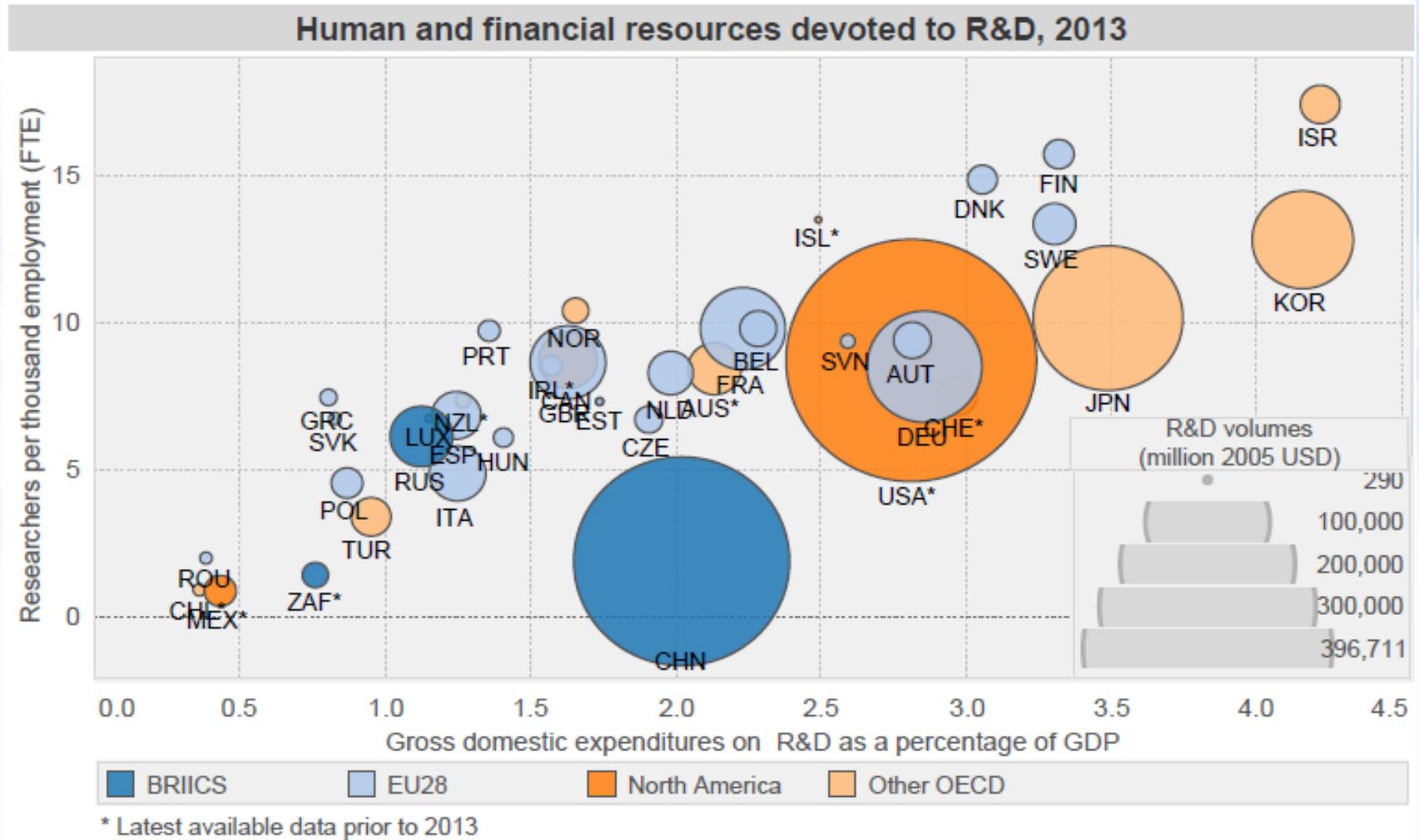


Plasma reactor for abatement of PFCs gases emitted from the semiconductor manufacturing process

GDP, R&D and Manufacturing Share (2013):



Human and financial resources devoted to R&D:



Obama's presentation in the State of the Union:

2012 - President Obama announces new National Network of Manufacturing Innovation

Original plan - \$1B invested in a network of 16 institutes of manufacturing innovation.

Carnegie Mellon 2012



National Network of Institutes of Manufacturing Innovation

2012 America Makes – 3D Additive Manufacturing, Youngstown Ohio, \$70M

2013 DMDII Digital Manufacturing & Design, Chicago, Illinois, \$150M

2013 LIFT Lightweight Metal Manufacturing, Ohio, Michigan, \$150M

2014 Power America -Wide-Bandgap Semiconductors North Carolina, \$150M

2014 IACMI –Advanced Composite Manufacturing, Purdue, Indiana, \$150M

2015 IP – Integrated Photonics, Rochester, NY \$610M,

2015 Institute of Flexible Hybrid Electronics Manufacturing , \$200M

Clean Energy

Revolutionary Fibers and Textiles

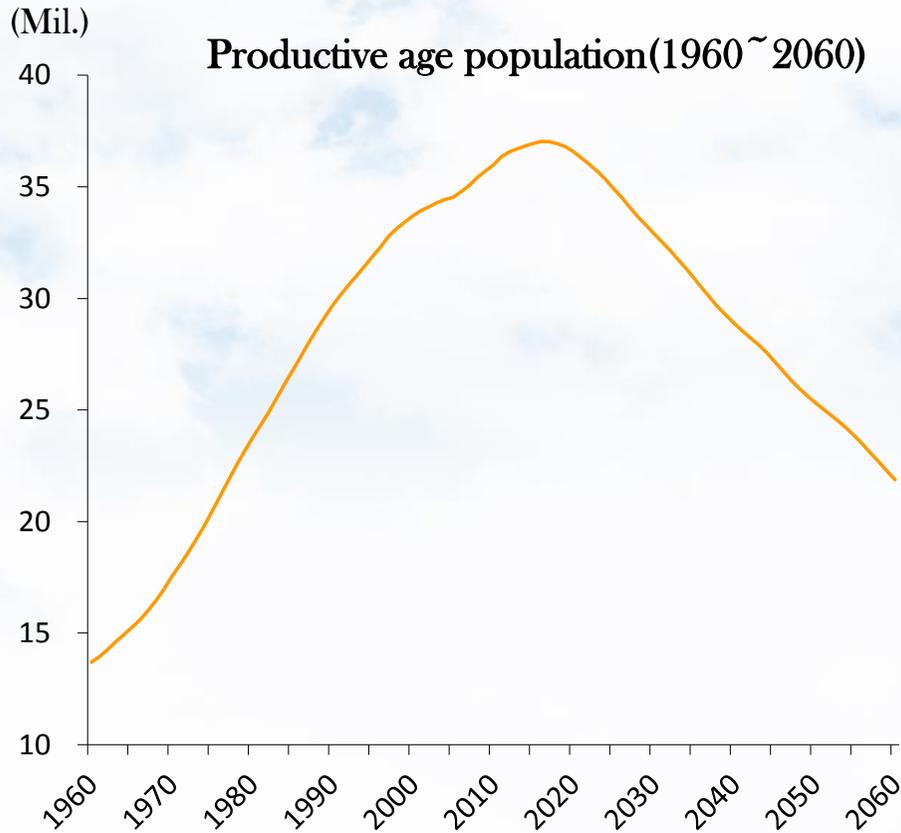
Challenges:

- **Renovation of the Internal R&D Operating System:**
 - Promotion of Flagship Projects
 - Increase of World Class Leading Edge Research Groups
- **Globalization:**
 - Promotion of Global Network and Working Environment
 - Global Commercialization of Maglev and Sharing the Experiences
- **Improvement of Public & Laboratory Safety:**
 - Enhancement of Laboratory Safety
- **Increase of the Research Productivity (royalty income / R&D budget):**
 - 6.6% (2013) → 7.6% (2017)

Socio-economic Changes:

■ Labor shortage due to birth rate drop

■ Decrease of number of students majored in natural sciences or engineering

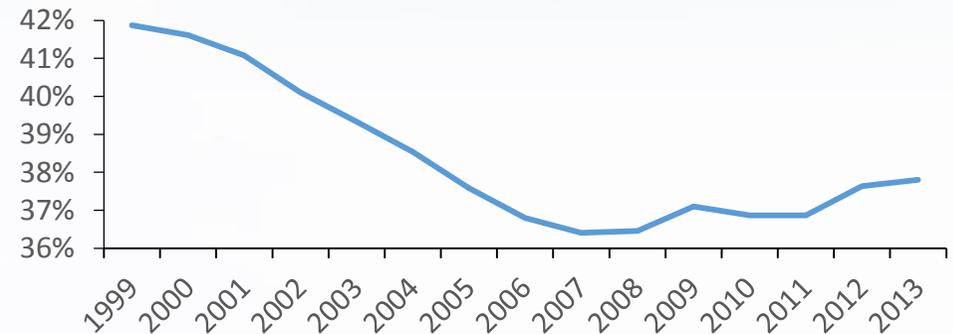


Source: Statistics Korea

- Performance in mathematics: 554
5th in the world, 1st in OECD (avg.: 490)
- Percentage of adults (25 - 34 yrs old) who have attained tertiary education: 66%
1st in OECD (avg.: 39%)

BUT,

Share of admission in natural sciences or engineering



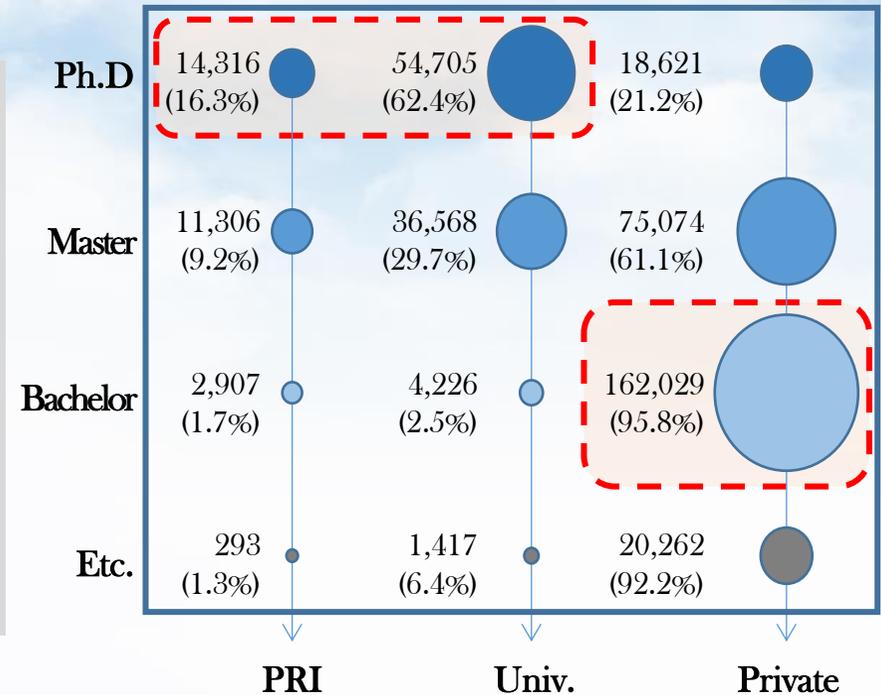
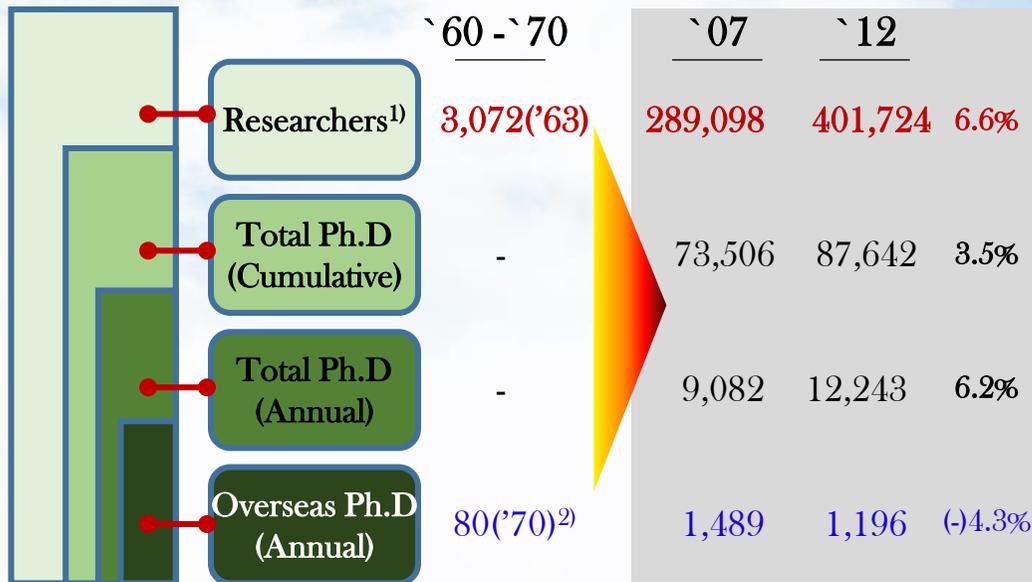
Source: Korean Educational Statistics Service

Change of R&D Manpower:

■ Over 400,000 research scientists in 2012 (6th in the world)

- Around 130 times increase compared to 1963: 3,072 ('63) → 401,724 ('12)

Statistics of Research Scientists



※ Data: NTIS, National R&D project survey report (KISTEP, 2012), etc.

1) Exception: Research assistants (Total researchers: 562,601 persons, including research assistants)

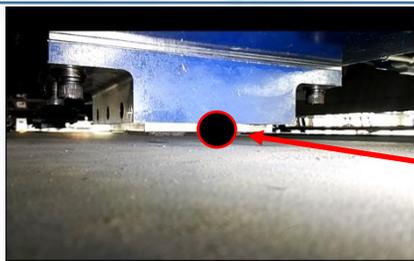
2) Ph.D. from overseas: 29 persons in 1965, 80 persons in 1970

Innovation: High-Speed Magnetic Vehicle Technology

KIMM's Technologies

Magnetic Levitation Vehicle:

- Stable Levitation Control (10mm)
- Lighter and Reliable Vehicle



10mm

Levitation Control



Test Magnetic Vehicle(2014.10.)

Applications

Super High-Speed Transportation:

- Max. operating speed: 500km/h
- Inter-City/State/National Link



Status

Test Vehicle Built:

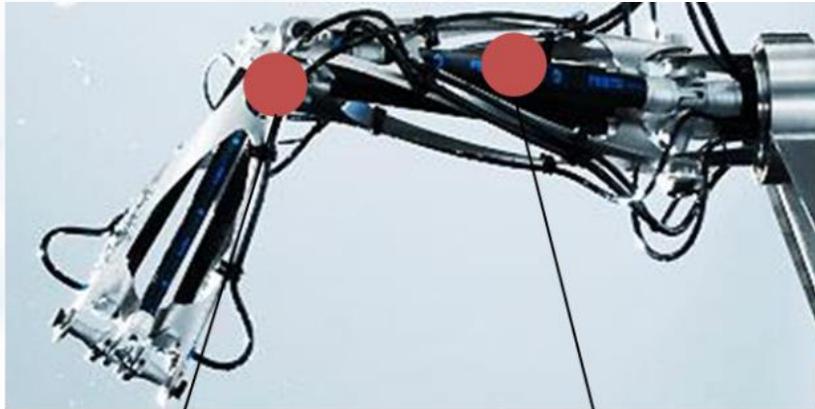
- Design Speed:550km/h
- Running Tests

Features

Vehicle without wheels:

- Eco-friendliness
- Higher Efficiency
- Cost Effectiveness

Innovation: Industrial Robot and Medical Devices



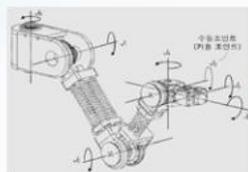
Needle type master robot



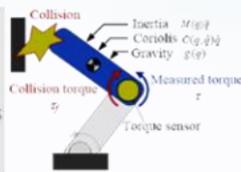
Personal mobility vehicle



High power density artificial muscle module



Low power actuator using elastic mechanism



Ankle-foot prosthesis

Innovation: Meta Materials Research

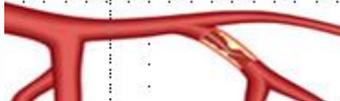
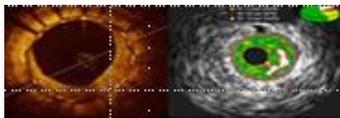
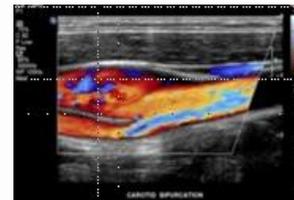
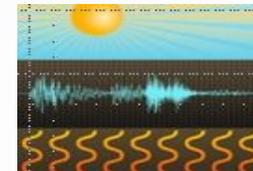
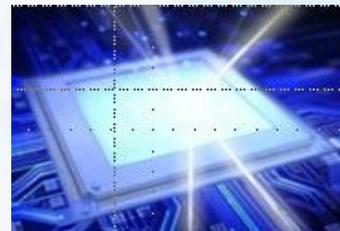
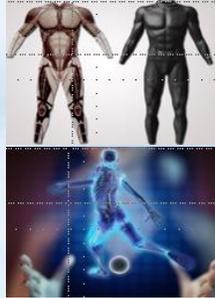
National Research Center for Wave Energy Control:

■ Global Frontier Project:

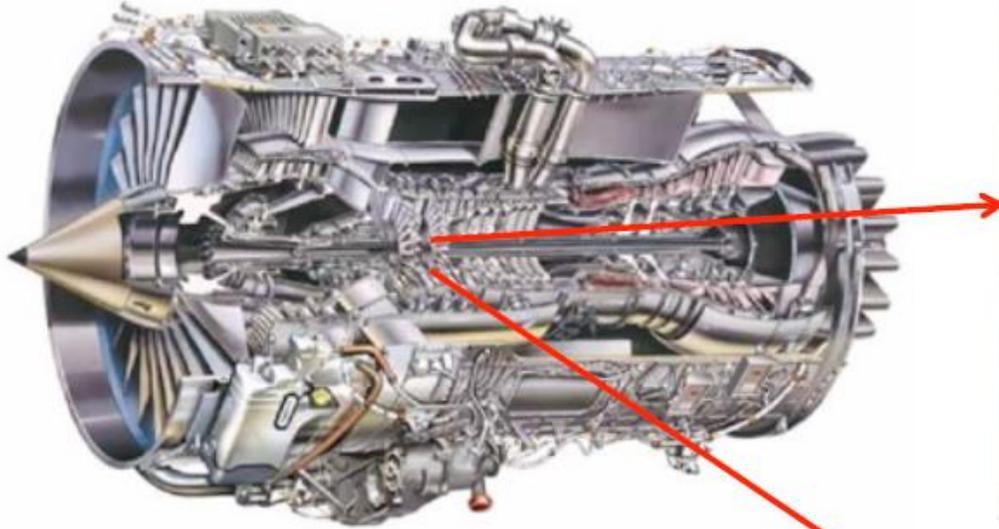
- Funded by the Korean Research Foundation (111M US\$)
- Period: 2014-2022 (9years)

■ Meta Materials System Engineering (MMSE) based on the control of electromagnetic & magneto-hydrodynamic wave energy:

- Convergence with Machinery
(MMSE of electromagnetic & magneto-hydrodynamic wave + Machine industry)
- Convergence with Information & Communication Technology
(MMSE of electromagnetic wave + ICT industry)
- Convergence with Energy Technology
(MMSE of electromagnetic & magneto-hydrodynamic wave + Renewable energy)
- Convergence with Bio/Medical Technology
(MMSE of electromagnetic & magneto-hydrodynamic wave + Next-generation bio/medical industry)



Innovation: 3D Printing



Source: Rolls-Royce Deutschland Ltd & Co KG

Example: Compressor BLISK

Conventional Manufacturing
200+ hours for CNC milling

Additive Manufacturing I
20 hours SLM complete build-up

Additive Manufacturing II
8 hours LMD cladding on a prefab disk



Institutional Spirit Building:

Knowledge: technology development for future needs

Innovation: value creation by integrating and convergence

Motivation: development of interactive culture for better communication and harmony

Marketability: market-oriented R&D

An aerial photograph of the KIMM campus, showing various buildings, green spaces, and a large forested area. The text 'THANK YOU!' is overlaid in large, bold, blue letters with a white outline.

THANK YOU!

<http://www.kimm.re.kr>