The 2021 Survey on the Technology Cooperation of China-Japan-Korea

(Final version 8/19/2021)

Chinese Academy of Engineering, the Engineering Academy of Japan and the National Academy of Engineering of Korea conduct the 9th perception survey on the technology cooperation of China, Japan, and Korea, aiming to provide a cooperative platform for mutual development of the East Asia to resolve common issues laid in the region. As in the last eight surveys, co-prepared by the members of the National Academies of Engineering of the three countries, the questionnaire is articulated in three sections:

Section I, the Cooperation Indicator will help annually monitor current trends and conditions among these three countries. Section II, the Fact-finding Survey will explore technology in whatever specific sectors are the subject of special focus throughout a given year. Section III is a questionnaire on personal matters, and we intend to analyze it in connection with the results of the previous two-section surveys.

The fact-finding survey for this year focuses on Microelectromechanical Systems (MEMS, also known as *microsystems technology* in Europe, or *micromachines* in Japan). MEMS integrate microcircuits and micromachinery on a single chip according to functional requirements with the characteristic length of generally micron and sometimes nanometer. As a fusion product of physics, chemistry, biology, electronics, mechanics, materials science, etc., MEMS are powered by many advanced technologies in microscopic fields including fabrication, packaging and testing. Micro-fabrication of MEMS is similar to batch processing for integrated circuits including oxidation, lithography, etching, etc., while some unique methods such as sacrificial layer process and LIGA have also been developed. Compared with traditional sensors and actuators, MEMS present the advantages of small size, light weight, high performance, low cost, low power consumption and good consistency.

Thank you in advance for your participation.

I. Survey on Cooperation Indicator

1. Do you think technological cooperation is necessary among China, Japan, and Korea? ( )

A. Very necessary

B. Necessary

C. Neutral

D. Unnecessary

2. Do you think technological cooperation among China, Japan, and Korea would be mutually beneficial? ( )

A. Very beneficial

B. Beneficial

C. Somewhat unbeneficial

D. Completely unbeneficial

3. In terms of quantity, how would you evaluate the level of technological cooperation among China, Japan, and Korea? ( )

A. Very high

B. Somewhat high

C. Neutral

D. Low

4. In terms of quality, how would you evaluate the level of technological cooperation among China, Japan, and Korea? ( )

A. Very high

B. Somewhat high

C. Neutral

D. Low

5. What is your opinion on the future prospects for technological cooperation among China, Japan, and Korea? ( )

A. Very optimistic

B. Optimistic

C. Pessimistic

D. Very pessimistic

II. Fact-finding Survey

II-1. MEMS for automobiles

MEMS technology has achieved its first large-scale application in automotive electronics industry. According to statistics, there are more than 40 sensors based on MEMS technology used in a high-end car, most of which are pressure sensors, accelerometers, flow sensors and gyroscopes. With the development of new energy vehicles, Internet of vehicles, and auxiliary/autonomous driving technologies, the level of automobile intelligence is rapidly improving, which also brings new opportunities and challenges to the development of related MEMS.

1. How much do you know about MEMS for automobiles? ( )

A. I don't know

B. I'm not sure

C. I know something about it

D. I know it very well and my work has some relevance

E. I know it very well and my work is closely related

2. Among the applications of MEMS listed below, which do you think are the most important for automotive safety? (Choose 3 items and rank them in descending order of importance) ( )

A. Electronic Stability Program (ESP) (Anti-lock Braking System (ABS) and Acceleration Slip Regulation (ASR), etc.)

B. Tire Pressure Monitoring System (TPMS)

C. Engine management system (Electronic Fuel Injection System (EFI), Exhaust Gas Recirculation System (EGR), oil pressure monitoring and anti-shake of engine, etc.)

D. Power steering system (Electronic Hydraulic Power Steering System (EHPS), Electric Power Steering System (EPS), etc.)

E. Transmission Control Unit (TCU)

F. Electrical Park Brake System (EPB)

G. Hill-launch Assist System (HAS)

H. Electronic Control Suspension System (ECS)

I. Side airbag triggering

J. Anti-theft detection system

K. Tank pressure monitoring

L. Inertial navigation

M. In-car heartbeat detection

N. Others ( )

3. Among the applications of MEMS listed in the previous question, which do you think are the most important for automotive comfort? (Choose 3 items and rank them in descending order of importance) ( )

4. Among the application trends of MEMS listed below, which do you think will be marketable in the next 10 years? (Multiple choice) ( )

A. External environment monitoring

B. New energy system status monitoring

C. State monitoring of vehicle occupants (ECG, fatigue level, etc.)

D. Passenger-vehicle information interaction

E. Intelligent noise reduction in the car

F. Others ( )

II-2. MEMS for healthcare

Healthcare industry offers a very promising prospect for MEMS technology, which is now playing an important role in the fight against COVID-19. In the future, with the increasing income of residents in China, Japan and Korea, the demand for a healthier life will continue to rise. In addition, the aging trend of population, obesity and cardiovascular and cerebrovascular diseases are getting more and more attention. All these factors will greatly promote the technical development and market expansion of related MEMS. ( )

1. How much do you know about MEMS for healthcare?

A. I don't know

B. I'm not sure

C. I know something about it

D. I know it very well and my work has some relevance

E. I know it very well and my work is closely related

2. Which factors do you think are the most important to increase the life expectancy of the population? (Choose 3 items and rank them in descending order of importance) ( )

A. Drug development

B. Rapid pathologic diagnosis

C. Biomedical research

D. Daily health monitoring

E. Artificial organs

F. Noninvasive/minimally invasive surgery

G. Others ( )

3. Among the following applications of MEMS (in vitro), which one do you think is the most promising? ( )

A. Biosensors (measuring physical and chemical properties of proteins, cells, tissues, etc.)

B. Biochemical analysis and disease diagnosis (genomic and proteomic microarray chips, Polymerase Chain Reaction (PCR) chips, Point-of-Care chips, etc.)

C. Tissue engineering (culture, manipulation of cells and tissues, construction of organs on a chip, etc.)

D. Others ( )

4. Among the following applications of MEMS (wearable/implantable), which ones do you think are the most promising? (Choose 3 items and rank them in descending order of importance) ( )

A. Intrusive testing (capsule endoscopy, etc.)

B. Minimally invasive surgery (minimally invasive surgical robot, etc.)

C. Miniature drug delivery injection system

D. Micro artificial organs (cochlear implant, bionic eye, etc.)

E. Articles for the disabled (guide walking stick, guide shoes, etc.)

F. Daily health parameters monitoring (wearable/implantable ECG, pulse, blood pressure, breathing, sleep, intraocular pressure, exercise monitoring, etc.)

G. Flexible chips (electronic skin, etc.)

H. Body energy harvesting

I. Others ( )

II-3. MEMS in other fields

The development of MEMS technology has brought about a revolution in many fields, which has affected almost every aspect of people's daily life. Intelligent Microsystems, which take MEMS technology as the key and integrate sensing, actuation, computing, storage, energy and other functions, are developing rapidly and will become the infrastructure of smart city and smart life in the future.

1. Which applications of MEMS do you think are the most important for the development of the national economy, including automotive and health care? (Choose 3 items) ( )

A. Vehicles (including Unmanned Aerial Vehicles (UAVs))

B. Medical equipment

C. Personal computers and smartphones

D. Wearable devices

E. Aerospace

F. The Internet of things

G. Robots
H. Virtual Reality/Augmented Reality
I. Industrial Internet
J. Body/Environmental energy harvesting
K. Analytical instruments
L. Others ( )

2. How important do you think the cooperation between China, Japan and South Korea in MEMS technology is? ( )
A. Very important
B. Relatively important
C. Generally important
D. Not very important
E. Not important at all

3. In what areas do you think China, Japan and Korea should cooperate in MEMS technology? (Multiple choice) ( )
A. Fundamental research
B. Prototype design
C. Advanced process development
D. Professional personnel training
E. Industry standard establishment
F. Others ( )

III. Personal Information

1. Have you participated in some form of technological cooperation with Korea, China, or Japan during the last five years? If yes, how many times?

If you are from China, please fill in the blanks below.
A. Japan: ( ) case(s)
B. Korea: ( ) case(s)
C. China-Japan-Korea: ( ) case(s)

If you are from Japan, please fill in the blanks below.
A. China: ( ) case(s)
B. Korea: ( ) case(s)
C. China-Japan-Korea: ( ) case(s)

If you are from Korea, please fill in the blanks below.

A. China: ( ) case(s)
B. Japan: ( ) case(s)
C. China-Japan-Korea: ( ) case(s)

2. Your profession ( )
A. Professor
B. Researcher
C. Business employer or employee
D. Government official or public sector employee
E. Other:

3. Your area of specialty ( )
A. Civil and environmental engineering
B. Mechanical engineering
C. Technology management
D. Material and energy resource engineering
E. Electric/electronic engineering & ICT
F. Chemical and biomedical engineering
G. Other:

4. How long have you been engaged in your research field? ( )
A. Less than 5 years
B. 5-10 years
C. 10-20 years
D. More than 20 years

5. Your age ( )
A. 35-49
B. 50-59
C. 60-69
D. 70-79
E. 80 and older

** If you have any suggestions or feedback on this survey, please comment below.

Thank you very much for your input. Your information will not be used for any purpose apart from this survey.