“Fifth Industrial Revolution” Cultivated with Biotechnology

- Backed by recent advancement of biotechnology as seen in cost reduction of genome-decoding, arrival of innovative genome-editing technology, and integration of biotechnology and AI, IT and other digital technologies, a “bioeconomy” is considered to be arriving worldwide creating a society in which biotechnology is utilized in all “monodzukuri” (manufacturing) areas, such as healthcare and medical care, energy and highly-functional materials.
- The government formulated a Strategy for Biotechnology in 2019 and has upheld its goal of realizing a globally-advanced bioeconomy in 2030 in Japan.
- Against this backdrop, the Bio-Industry Subcommittee held discussions on measures contributing to further improving the competitiveness of the bio-industry in Japan as a pillar supporting industries leading the next-generation economy, and compiled the discussion results into a report.

1. Background (development of synthetic biology)

- Cost reduction of genome-decoding (one-100,000th from the cost in 2000)
- Birth of innovative genome-editing technology (CRISPR-CAS9)
- Development of IT/AI technologies allowing analysis of relationships between genome sequences and biofunctions

Creation of “Smart Cells”

Design
- Designing such cells at the genome level

Build
- Gene synthesis
- Genome editing

Learn
- Learning using AI and IT technologies

Test
- High throughput technology

DBTL cycle

Smart Cells
- Dramatically improving the productivity of useful materials
- Core
- Raw materials of highly-functional materials, e.g., functional polymers

Summary of the FY2020 Report compiled by the Bio-Industry Subcommittee of the Commerce, Distribution and Information Committee under the Industrial Structure Council, METI
2. Recognition of current situations (industrial development placing biotechnology at the core)

- The market scale of the bio-industry is expected to grow for the coming five years with 7.0% annual average growth at a global level and by 6.8% in Japan as well.
- Forty-nine countries around the world have formulated strategic policies related to the development of bioeconomy.
- The government of Japan is increasing expenditures for R&D in the field of healthcare along with the U.S., the U.K., Germany and the ROK, showing intensifying international competition in the field.
- Japan’s international competitiveness in basic research in the field of life science has been decreasing.
- Challenges are seen in the low reproducibility unique to biology, low research efficiency, risks of infection, etc.
- Human resources expertized in DX for the bio-industry and those playing leading roles in manufacturing of biological products are insufficient.

3. Directions of future efforts

(1) Improving productivity by introducing robots and automation
- Accelerating introduction of automation into phases of R&D and product development by making use of humanoid experimental robots and combinations of devices modularized for each operation

(2) Formulation of a global biocommunity
- Formulating global bio-innovation hubs in the Tokyo and Kansai areas to facilitate a virtuous cycle of people, goods and money
- Inaugurating a Greater Tokyo Biocommunity Council in the Tokyo area as a body executing leadership in industry-academia-government collaboration and formulating and presenting a master plan containing specific actions and quantitative goals

(3) Fostering human resources expertized in DX for the bio-industry and that can play leading roles in manufacturing of biological products
- Building a system reflecting the latest demands of companies and academic knowledge; and establishing a sustainable ecosystem for fostering human resources through industry-academia-government collaboration

(4) Priority Research issues to be tackled
- Formulating a strategy for life science technologies in the fields of health care and medical care, that organizes and prioritizes R&D issues to be tackled
- Facilitating R&D for establishing advanced basic technologies, e.g., cell-free technology

(5) Enhancing the competitiveness of CMOs/CDMOs of bio-pharmaceuticals, etc.
- Encouraging CMOs/CDMOs to participate in national projects which are intended to develop manufacturing processes in order to enhance Japan’s ability to deal with new technological seeds
- Discussing specific support measures from the perspective of securing domestic infrastructures for manufacturing

(6) Disseminating bio-derived products
- Reviewing the Label Display Program in order to encourage markets to choose bio-derived products
- Inaugurating an award program to recognize development and utilization of pioneering bio-derived products

Correctly ascertaining changes brought about by the “fifth industrial revolution” by taking advantage of the combination of biotechnology and IT/AI and improving the competitiveness of the bio-industry in Japan.