

Chapter 4

Science, Technology, and Innovation
by Colleges of Technology (KOSEN) Based in Regions Across Japan

This chapter introduces colleges of technology (KOSEN) and their initiatives as players that contribute to resolving regional challenges. Colleges of technology (KOSEN) contribute to the promotion of local industries and the development of human resources through their unique curricula and projects, and are expanding their networks nationwide. Practical education through industry-university-government collaboration has also been effective in creating the next generation of startups.

Section 1 What are Colleges of Technology (KOSEN)?

Colleges of technology (KOSEN) are higher education institutions whose purpose is to train practical and creative engineers. There are a total of 58 national, public, and private colleges of technology (KOSEN) throughout Japan, with approximately 60,000 students enrolled. Students who have graduated from junior high schools can enroll in these colleges in the same manner as enrolling in a high school. Once enrolled, they can obtain the educational enrichment and systemic, specialized knowledge necessary to become an engineer in five years (five years and six months for students in Maritime Technology Departments) through a well-balanced curriculum of general and specialized subjects. In order to equip students with the ability to apply what they have learned, colleges of technology (KOSEN) emphasize experiments and practical training in addition to theory, and aim to develop engineers with a sense of creativity through their graduation research. Furthermore, students hone their technical skills by competing in national competitions such as the Robot Contest, Programming Contest, Design Competition, and Sports Festival, where they are able to demonstrate the results of their daily studies. In recent years, the KOSEN Deep Learning Contest (DCON) has been held. This is a contest in which students create projects that utilize the manufacturing technology and deep

learning skills they have cultivated through their day-to-day studies and compete to receive the highest business valuation based on their project's feasibility. As part of the screening process for the teams competing in DCON, the value of each project based on its feasibility is quantified in terms of a business valuation amount and investment amount. The business valuation of the winning team has been increasing over the years to 500 million yen, 600 million yen, and 1 billion yen in 2020, 2021, and 2022, respectively.

In addition, colleges of technology (KOSEN) are leveraging these results to contribute to regional revitalization and local innovation through joint research with industrial sectors, commissioned research, technical consultations, and public seminars for local residents. Graduates are highly evaluated by industrial sectors, and those applying for jobs enjoy a high employment rate and a high ratio of job openings. The employment rate of job applicants is almost 100%, and approximately 50% of those who find jobs are employed in the manufacturing industry. Thus, colleges of technology (KOSEN) are producing talented personnel who support Japan's industries and economy. It is also possible for students to transfer into their third year at a four-year university upon graduating from the five-year regular course, or to obtain a bachelor's degree

upon completing a two-year advanced course at a college of technology (KOSEN) and passing the examination by the National Institution of Academic Degrees and Quality Enhancement of Higher Education (NIAD-QE).

The term “KOSEN” is beginning to gain recognition overseas and is highly evaluated by the international community. One example of this is the opening of KOSEN-KMITL (established by King Mongkut’s Institute of Technology Ladkrabang) in Thailand in May 2019, followed by KOSEN KMUTT (established by King Mongkut’s University of Technology Thonburi) in June 2020, which are the first and second full-fledged colleges of technology (KOSEN) modeled after Japan’s

KOSEN system. Faculty members were dispatched from Japanese colleges of technology (KOSEN) to provide guidance and training to local Thai faculty members, as well as to support the acceptance of Thai students in Japan and the preparation of teaching materials, thereby contributing to the development of practical and innovative engineers capable of supporting industries in Thailand. The National Institute of Technology also provides support to local educational institutions in Mongolia and Vietnam, offering administrative and operational advice, joint development of educational curricula and teaching materials, and faculty training.

Section 2

Collaborative Initiatives with Local Communities Supported by the Inter-College Network

Colleges of technology (KOSEN) are mainly composed of departments in the field of engineering, such as Mechanical Engineering, Materials Science, Electrical and Electronics Engineering, Information and Telecommunication Engineering, Chemistry and Biochemistry, Civil Engineering, and Shipping Technology. The composition differs from college to college, but each college offers an education that takes advantage of the strengths and characteristics of the local region. Collaboration leveraging the inter-college network across the country has been progressing. For example, the KOSEN-1 satellite, launched by the Epsilon-5 Launch Vehicle in 2021, was developed through a collaborative project involving more than 50 students from 10 colleges of National Institute of Technology (Kochi KOSEN, Gunma KOSEN, Tokuyama KOSEN, Gifu KOSEN, Kagawa KOSEN, Yonago KOSEN, Niihama KOSEN, Akashi KOSEN, Kagoshima KOSEN, and Tomakomai KOSEN), led primarily

by Kochi KOSEN.

Since FY2020, the National Institute of Technology has been implementing the “Project for the Development of ‘Future Engineering Human Resources for Society 5.0’ at KOSEN.” Fully leveraging its organizational advantage of having 51 colleges (KOSEN) of the National Institute of Technology under the umbrella of a single entity, the Institute is working to solve regional challenges in each of 10 fields (including materials, energy and the environment, and disaster prevention/mitigation/epidemic prevention) through collaboration among colleges of technology (KOSEN) and utilization of business seeds.

In recent years, semiconductors have become a key technology supporting efforts toward digitalization, decarbonization, and economic security, and countries around the world are competing fiercely to secure bases of production for advanced semiconductors. To support increased

domestic investment in the semiconductor industry, Japan has invited TSMC, one of the world's top semiconductor manufacturers in Taiwan, to open a plant in Kumamoto. It is estimated that this invitation will bring in more than 4 trillion yen in economic effects and create more than 7,000 jobs over a ten-year period, which will significantly contribute to the revitalization of the region. To keep pace with such major trends in the semiconductor industry, the Kyushu Semiconductor Human Resource Development Consortium was launched in March 2022. In cooperation with the consortium, the National Institute of Technology is working to build a system that enables students nationwide to acquire knowledge and skills related to semiconductors, with a particular focus on nine colleges of technology (KOSEN) in the Kyushu and Okinawa regions. Specifically, the Institute is accelerating collaboration with public organizations, semiconductor-related companies, and universities in the Kyushu region through the participation of Kumamoto College (Kumamoto KOSEN) in Kumamoto Prefecture's Kumamoto Semiconductor Human Resource Development Council, the

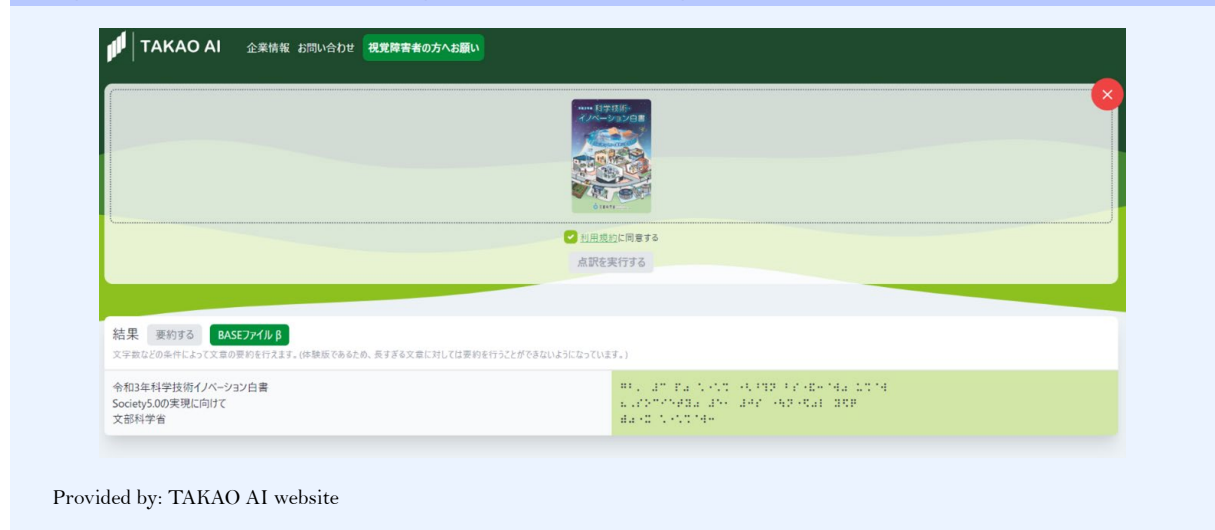
participation of Sasebo College (Sasebo KOSEN) in Nagasaki Prefecture's Nagasaki Semiconductor Network, the participation of Oita College (Oita KOSEN) in Oita Prefecture's Oita LSI Cluster Promotion Council, and so on. At the same time, the National Institute of Technology is participating in the TOHOKU Study Group on Design of Semiconductor and Electronics Industry, the Liaison Council for the Development of Semiconductor Human Resources, etc. in the Chubu Region, and the Council for the Promotion of Semiconductor-related Industries in the Chugoku Region to accelerate the development of semiconductor-related human resources at all colleges of technology (KOSEN) nationwide. The Institute aims to produce not only talented personnel who leverage the strengths of colleges of technology (KOSEN) through their practical skills, but also top-class research and development-oriented personnel in collaboration with universities and enterprises. At the same time, the educational programs developed are being expanded nationwide beyond the Kyushu region through remote and on-demand seminars.

Section 3 Innovations from Colleges of Technology (KOSEN)

In order to realize a new form of capitalism, it is essential to foster startups that will promote Japan's economic growth and resolve social issues from a variety of approaches. Above all, it is important to provide support for young talented personnel with excellent technical skills and flexible ideas. In recent years, there have been cases of students with high technical skills, the motivation to contribute to regional society, and the ability to think freely—attributes they developed at colleges of technology (KOSEN)—starting their own businesses. In order to accelerate the development of human resources

who will create such startups in Japan, we are supporting strategic initiatives such as the development of “entrepreneur workshops,” an educational environment where students are allowed to freely develop products and challenge themselves in practical endeavors at colleges of technology (KOSEN) that excel in the development of startup human resources.

Figure 1-4-1/Braille translation generated from an image file



Through these initiatives, ideas that lead to entrepreneurship are being generated one after another at colleges of technology (KOSEN). One specific example is a case from the National Institute of Technology, Tokyo College (Tokyo KOSEN). The Tokyo KOSEN team that participated in the DCON 2020 competition held in 2020 proposed a Braille translation engine called :::doc (Tendoc), for which they won the Grand Prize and Young Developer Encouragement Award. This system uses a proprietary AI model to analyze image data input and automatically translate it into Braille. Users simply upload a photo of a document that needs to be translated into Braille, and the results will appear on the screen in seconds. By using deep learning and other methods, this system improves recognition accuracy, speeds up processing time, and can generate summaries of text (Figure 1-4-1).

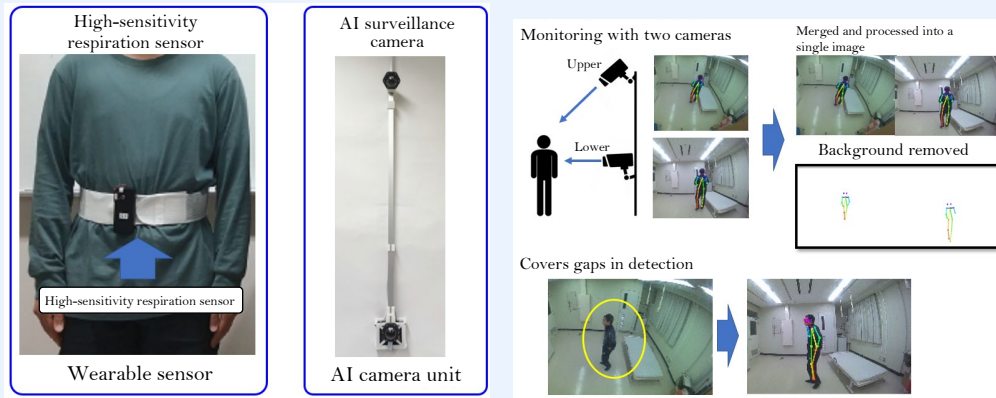
Building on this technology, the team members who participated in DCON went on to found TAKAO AI, Ltd. in 2021. This company aims to overcome various barriers to information access in society by providing a system that automatically outputs the content of documents via a Braille display device simply by photographing print materials with a tablet or smartphone. TAKAO AI was also the first company to receive an investment

from the committee managing the 100-million-yen fund for DCON start ups.

Several other startups have originated from colleges of technology (KOSEN).

Currently, the health status of patients at hospitals and elderly care facilities is visually checked during regular rounds. However, due to Japan's declining population and its decreasing birth rate, coupled with advanced aging, hospitals and elderly care facilities are expected to face a shortage of personnel at the same time as the number of elderly people reaches its projected peak around 2040. To resolve this issue, members of the National Institute of Technology, Kagawa College (Kagawa KOSEN) have developed the "NanShon" Health Monitoring System, a system that monitors the health status of individuals by measuring their vital data (respiration rate and heart rate) using a respiration sensor, while using deep learning to monitor the state of hospitalized patients or elderly individuals through images of their rooms while ensuring their privacy. This proposal, which placed fourth among the competing teams at DCON 2022, received the coveted MEXT Minister's Award as well as a corporate valuation of 750 million yen if the proposal were to be actualized (Figure 1-4-2).

Figure 1-4-2/A system comprising a respiration sensor and surveillance camera



Provided by: National Institute of Technology, Kagawa College (Kagawa KOSEN)

In addition, IntegrAI, a startup company originating from the National Institute of Technology, Nagaoka College (Nagaoka KOSEN), was founded in July 2020. Its main product, the IntegrAI Camera, is a small camera with a built-in AI. The idea came about when the current CEO participated in DCON 2019 with other KOSEN students, and won the competition by developing a system called METERAI, which uses AI to read needles on meters via webcam video. The technology behind METERAI was the foundation of the current technology in the current IntegrAI Camera. The company is also funded by Deep30 Inc., Japan's first venture capital firm specializing in deep learning, which was spun out from the Matsuo Lab at the Graduate School of Engineering, The University of Tokyo.

The IntegrAI Camera can replace people in

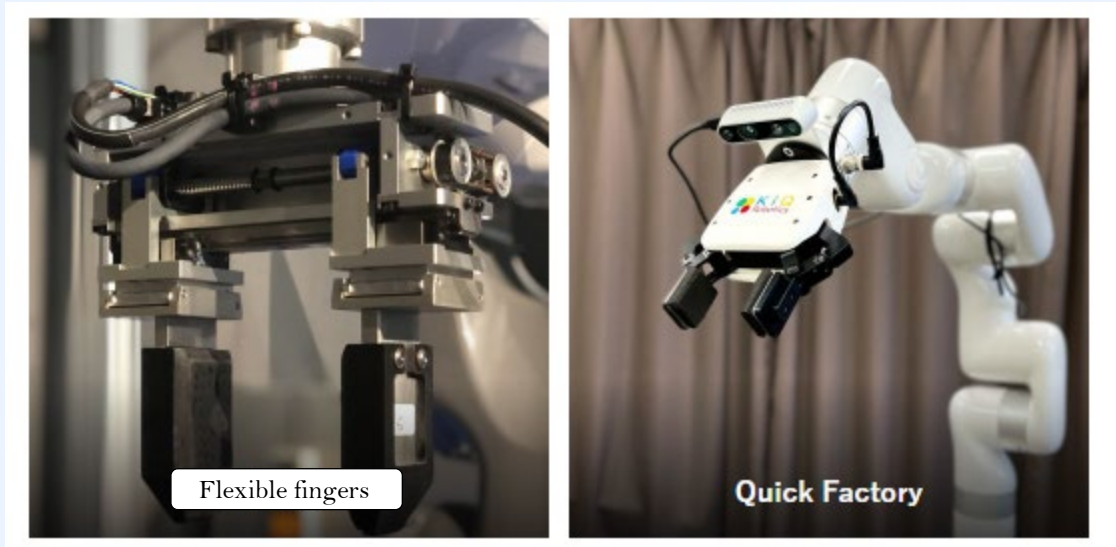
handling work that previously required them to check instrument readings on a regular basis. Organizations such as universities, research centers, and companies still rely on many analog devices. IntegrAI promotes digital transformation by capturing a variety of analog devices on video and using AI to digitize and monitor the data, enabling organizations to obtain highly accurate readings of devices in factories and other locations, set alarms for abnormalities, and manage devices remotely even when personnel are not on site. This product is being used in a variety of applications, including a system for controlling the temperature of freezers that store COVID-19 vaccines and a system for reading thermometers and hygrometers in the Japan Aerospace Exploration Agency's (JAXA) H3 rocket fuel storage area (Figure 1-4-3).

Figure 1-4-3/Freezer temperature control system that uses the IntegrAI Camera



Source: IntegrAI website

■ Figure 1-4-4/ Flexible fingers and QuickFactory



Source: KiQ Robotics website

KiQ Robotics Inc., a startup company originating from the National Institute of Technology, Kitakyushu College (Kitakyushu KOSEN), has created a robot hand capable of gripping objects with the “just right” amount of force, which has been considered difficult to achieve until now, by reproducing the flexible structure of human fingertips using resin. The company has successfully developed the “Quick Factory” robot package, which incorporates software that can automate tasks using these “flexible fingers” with only two photographs—the before and after photos of the task. It has also developed AI technology capable of removing only objects that contain foreign matter, such as removing only contaminated bottles from collected plastic bottles (Figure 1-4-4).

The founder of KiQ Robotics, Takashi Takimoto, was an assistant professor at Kitakyushu KOSEN at the time of the company’s establishment, but has since devoted himself to running the company and starting a new company, Next Technology, LLC. One day, the president of a local company shared a story with Takimoto about how his family told him that his feet smelled bad, and how he wished that

there was a device which would inform him of this fact in a pleasant manner. This inspired Takimoto to develop a dog-shaped robot that would react to smells by falling over. In addition, his company has developed a series of unique products, including a product that emits aromas when it detects stress. In order to use technology to resolve problems faced by local governments and local businesses, Takimoto makes use of various networks to listen to the voices of people facing difficulties.

As these examples illustrate, colleges of technology (KOSEN) are rooted in the community, nurturing highly talented personnel in line with local needs, and are using their strengths and abundance of ideas to resolve local issues. In addition, the Government of Japan is contributing to regional innovation by encouraging the creation of startups originating in colleges of technology (KOSEN) through such measures as the Project for Improving the Educational Environment for Generating Startups at Colleges of Technology included in the second supplementary budget for FY2022. Each region is connected with each other through a network of local colleges of technology (KOSEN), and by leveraging each other’s strengths,

these colleges of technology (KOSEN) have innovation in Japan.
become an indispensable part of regional