Welding with a large arm, sending sparks flying, and installing parts at incredible speeds, industrial robots in the past were exclusively seen as a part of an automated production line, and the image of working side-by-side with humans was not common. However, in recent years, more companies are taking on the challenge of establishing a new style of production, in which robots are part of the staff—just like humans—on the assembly line and working in collaboration with humans. Behind this trend is the need to utilize the explosive innovations in robot technology as a solution to the problems facing Japan’s industrial sector. In addition, the increasing necessity for creating flexible assembly lines, including responding to the need for large-item small-volume production, is another reason why the next-generation robot is attracting attention.

An answer to problems

The government presented a policy titled “Achievement of a new Industrial Revolution driven by robots” in June 2014 in its new growth strategy. How can we cope with the decreasing labor force due to the declining birth rate and aging population, and the subsequent increasing workload? Increasingly high hopes for next-generation robots are evident not only at production sites but also in areas such as medical and nursing care, public infrastructure and disaster prevention.

At METI too, the robot industry is considered to be one solution to such problems, and as a growth industry for exploring global markets. The ministry is now in the midst of preparing some measures to guide the movement. In December 2013, government eased the “80W regulation of industrial robots” based on the Deregulation Action Program (refer to p.6 for further information). Now, by fulfilling certain conditions, it is possible to let industrial robots work together with humans without separating them with a barrier.

How will industrial robots work in the future? How will they coexist with humans at worksites? Let’s take a look at the frontline of worksites where robots work.
Autonomous and compact
It plays an active role as a multi-skilled worker

GLORY is a global company with a large market share in the area of currency processing machines, such as automatic teller machines available at financial institutions and machines which prepare change in cash registers, which play an important role in the retail and distribution industries. “The mainstream work of the company was being shifted to the overseas market, and we wanted to strengthen the competitiveness of domestic business establishments. That was the major reason for deciding to introduce NEXTAGE,” Mr. Tobita.

Mr. Tobita, who was at first thinking of creating a production line using conventional industrial robots, saw Kawada Industries’ NEXTAGE at the International Robot Exhibition in 2009 and fell in love at first sight. He intuitively knew how interesting an opportunity it presented and how well it would work in their company, and started operational testing in cooperation with Kawada Industries. After the purchase of the first edition model, it developed into a joint project to create a production line with 17 NEXTAGE units, in 2011.

Mr. Tobita was attracted to the fact that “The robot had a complete set of camera image recognition functions and two arms.” Moreover, it was compact, just about the size of the upper body of a person. He thought that the robot would not take up too much space and could be used like a multi-skilled worker. On the other hand, Mr. Shiroma said, “They have eyes and use two hands. It is our basic idea that robots should have ‘all-in-one’ functionality.”

Mr. Shiroma, from the Robotics Division of Kawada Industries, Inc., laughs, “I knew Mr. Tobita was used to media interviews, but he was shaking a bit that time.” Collaboration between the companies, thanks to the two men, started in October 2011. It was a joint development project of an automated production line, utilizing the humanoid robot “NEXTAGE”.

GLORY’s automated line is still evolving. The company is now trying to establish a system in which humanoids on trolleys move around the worksite to assemble an entire unit. However, “We don’t intend to handle everything over to robots. We can improve the system and seek ways to raise production efficiency only because there are humans who can offer fine-tuned follow-up,” Mr. Shiroma says.

Diffusion to small and medium enterprises may also be promoted if an environment allowing easier trials is created, suggests Mr. Shiroma. The effort is still at the beginning of a long road toward establishing a cooperative work. We cannot take our eyes off the evolution of co-“robo” ration, which should redefine the relationship between humans and robots.
Opportunities for robots to exert their potential

Hiroshima

"Eyes, hands and brain" applicable to random parts in development

At manufacturing sites, automation using robots is increasing for repetitive processes, such as the manipulation of parts, welding, assembly and product inspection. On the other hand, distinguishing between randomly piled parts is a task mainly carried out by humans. According to the Survey on the Needs of Robot Technology conducted by Hiroshima Prefecture in 2011, there was significant demand for "improving the efficiency of assembly systems" and the "automation of the process of installing parts on assembly lines" among companies within the prefecture. Accordingly, the Hiroshima Prefectural Technology Research Institute, together with the National Institute of Advanced Industrial Science and Technology (AIST), is currently engaged in the joint development of a "Random picking robot system." There are three challenges to tackle the development of image processing technology to accurately determine the position and alignment of parts (eyes), the creation of robot hands for reaching and grabbing parts correctly (hands), and control systems for the robots to control them as a whole (brain). The project aims to establish technologies and to create an inexpensive system so that small and medium enterprises can introduce the system at a lower cost. Research achievements are consistently being transformed to the companies, and some are already in the application stages. Hiroshima Prefecture is steadily advancing toward the goal of full automation of the assembly lines, under the slogan of "operating 24 hours a day, 365 days a year."

City of Kitakyushu

"Robot city," the home of a variety of robot development projects

Kitakyushu City is actively backing the promotion of the robot industry, including conducting an experiment involving robots traveling on public roads for demonstration purposes, ahead of other regions in Japan. There are various ongoing projects in the city, focusing on support for development and introduction, human resource development, and information transmission. One example is the City Center Robot Creation Project, an industry-academia collaborative project with the theme of "Robots developed in Kitakyushu." This development of "K-Robot" for manufacturing industries is now under way, following those used for the inspection of sewage pipes and for medical rehabilitation of upper limbs. Further, the city inaugurated "Consulting and training center for industrial robot" in order to support companies. The center offers practical support in such forms as consultation counters and "Robot Dojo," providing training in robot operation. In addition, the Center for Social-Robotic Synthesis was established in 2013 within Kyushu Institute of Technology, while Yaskawa Electric Corporation, with its head office in Hiroshima Prefecture Industrial Robots Project Team

Random picking robot

What had changed with the "easing of the 80W regulation"?

One of the factors that contributed to the advancement of the relationship between humans and industrial robots is the easing of the 80W regulation, implemented in December 2013. The regulation previously specified that robots with a maximum output power of "more than 80W" had to be separated from the working space of humans by a fence. However, this regulation was revised, and now it is possible for these higher-power robots to work together with humans, provided that "the robot manufacturer and the user take measures pursuant to the standards of industrial robots set by the International Organization for Standardization." This change is expected to have a variety of positive effects, such as the flexible creation of lines and the effective use of space.

New possibilities following the revision!

Click! Safety standards that make cooperative work possible

Smaller spaces and higher production efficiency!

Humans and robots can work together

Now higher-power robots, with a motor output power greater than 80W can also be operated without installing a fence provided certain conditions are met. This lowers the hurdles to introducing robots, as there is no longer a need for extra space or fencing associated with installing fences. It also allows the robot to share work with humans in close proximity. It is hoped that this will lead to utilization of robots in a wider range of areas, and a more flexible creation of assembly lines.
Industrial robots play a key role in manufacturing sites, even though they rarely receive a great deal of attention. When did these robots appear? How will they evolve in the future? Find answers to these questions here.

Q: What is the history of industrial robots?
A: It is said that 1980 is the first year of the robot industry expansion. The manufacturing industry in Japan experienced a major recession after the oil crisis in 1973. This triggered a shift in industry, from facilities for mass production to facilities with higher investment efficiency allowing for large-term small-volume production. In addition, the 1970s was also an era when robot-related technologies such as microprocessors and servomotors made rapid advances. Thus, societal needs for improvements in investment efficiency met with technical seeds, culminating in the “first year.” Despite economic fluctuations, the market for industrial robots in Japan has maintained its trend of expansion. The market is strong in 2014, and it is expected that shipment volume will mark its highest record in history, with exports to Asian countries increasing rapidly.

Q: How have the needs of manufacturing been changing?
A: Industrial robots used to be utilized mainly in the automotive industry, and especially for welding. Currently, about 40% of robots throughout the world are shipped for automotive and automobile parts industries. However, the trend is shifting from providing simple automation of workflow to focusing on the quality of solutions provided by robots. Industrial robots are semi-finished products. They become useful only after attaching hands or tools suitable to the final intended use, and completing the programming process. This situation highlights the importance of the system integrator, whose role is to design the entire system, incorporating the robots perfectly. The ability of the system integrator is instrumental in maximizing the usefulness of the system with the robots.

Q: I’m still concerned about safety measures.
A: Safety must be paramount in cooperative work between humans and robots. There are three main issues. The first is that the basic knowledge related to the safe management of robots and at the moment, relevant safety measures are not still fully understood by those who work in the manufacturing field. The second is that the current technical measures preventing accidents other than a safety fence are insufficient. For example, more focus is needed in improving and combining methods and technologies used to detect potential dangers and to protect from the dangers. The third is that it is relatively difficult to identify where the responsibility for safety measures lies. Who is responsible, the robot manufacturer, the system integrator, or the end user? It is important that the potential risks for each party be identified and that the respective scope of responsibility for safety be clarified, in order to get to the root of risks involved.

Q: What is Japan’s current competitiveness?
A: It is true that the performance of Japanese robots is superior. However, the adoption of robots made in China is also increasing for low-end products. Japan must continuously ensure we are on the cutting edge, because fiercer competition seems inevitable. In the case of machinery products in general, when someone purchases the same parts and assemblies them by copying examples, the finished product will have a perfection level of about 60% of the original. The reason for this inequality between Japanese and Chinese products stems from the fact that there are a large number of invisible, background processes that lead to our superiority in this respect. However, there is no doubt that others will reach the level of Japan in the future, even though it may take time. There is a broad range of issues that must be considered, including innovation in materials and key parts and the establishment of a mechanism for further collaboration among manufacturers and companies.

Q: What does the future hold for robots?
A: It is expected that they will develop differently depending on the specific needs that they meet, whether working at production sites in the manufacturing sector, maintaining civil infrastructure, or improving people’s lives in terms of medical and nursing care. It is necessary to understand the goals for the technology before introduction, focusing on needs in each area and potential use from the beginning, rather than considering production of a robot a value in itself. In the future, Japan should not only maintain its competitiveness in the face of other countries, but also assume an international leadership role as the world’s leading country in robotics. In areas such as international standardization, creating mechanisms for the industry, and the distribution of applied technology, leading the expansion of the market for the robot industry on a global scale will surely result in the discovery of truly valuable technology for the future.

Top left: Rescue robot that played a critical role by entering the site of the accident of TEPCO’s Fukushima Daiichi Nuclear Power Station. Bottom left: The detached half of the fuselage transfers into a wheelchair. It is a nursing care robot which allows for improved mobility. Right: Robot nursing care device in the form of “moving handrails” that assist elderly people with walking.