We held a two-day FANUC Open House event on April 14 (Tue.) and 15 (Wed.), in the Nature Hall of the headquarters. The event turned out to be very successful, with the number of visitors far exceeding those of last year. This year, with the slogan, “one FANUC,” a large number of new features were presented that linked the different FANUC product lines, developed beyond the frameworks of FA, ROBOT, and ROBOMACHINE. All of the visitors were very impressed with the products on display, saying that they offered a means of improving manufacturing productivity and increasing facility operation rates.

In the FA section, the New HMI was introduced on a special stage in the center of the event site. Presentations were given on a large screen, and an operator’s panel was prepared to enable visitors to actually operate the machine. As a result, a large number of visitors were able to experience the next-generation CNC. A FIBER LASER was also exhibited for the first time, and our efforts in the area of control technology using CO2 LASER were well received.

In the ROBOT section, all of the areas constantly drew interested crowds, mainly because they exhibited our latest models, such as the green Collaborative Robot, which is now shipped to customers, the 2-ton payload super-large robot designed to carry an entire car body, and the fully covered robot that can be used even in harsh environment.

In the ROBOMACHINE section, a large number of visitors were attracted by the ultra high-speed machining of steel and aluminum parts with ROBODRILL, the 130- and 220-ton two-material molding with ROBOSHOT, and the high-speed and high-precision machining of thick plates with ROBOCUT. In each case, an automated system that seamlessly incorporated robots was exhibited, giving visitors a lasting impression and the feeling that “If a factory is to be automated, let FANUC do it.”

In the Services section, we demonstrated preventive maintenance by actually performing the work in front of the visitors. By stressing “Service First,” which is one of FANUC’s fundamental principles, to visitors through specific examples, we emphasized that FANUC products can provide high levels of reliability in all corners of the world.
Major exhibited products

**FA**

CNC
- 30i-B Series CNC, with the new design and operation screen
- Total support of the work on site
- Flat surface, light operation
- Easy creation of machining programs
- Significant reduction in set-up time
- Interference prevention

New features of 30i Series
- Enhanced usability of 5-axis machine tool
- Reduction in machining time by leveraging spindle performance

New features of the 0i Series
- High-quality die cutting
- Work piece centering, tool offset measurement

**FANUC's CNC maximizing machining efficiency**
- Significant reduction in lathe turning time
- Visualization by linking machine tools together
- Centralized management of machine tool operating status and maintenance information

**Power Motion**
- High-speed and high-precision press and transfer control
- Wide lineup supporting high speed, high precision, and high efficiency
- Amplifier downsizing and 400-V support
- Downsizing and lineup expansion
- Machine and workpiece protection in event of power failure
- Adjustment-free, fastest tapping
- Visualization of CNC and servo operation

**LASER**
- High-speed and high-precision LASER processing

**ROBOT**
- Safety Fence-free robot with 35 kg payload
- Arc welding robot system
- High-speed and high-precision arrangement system for electronic parts
- High-speed arrangement system for food
- Intelligent deburring system with fully covered robot
- Medical and cosmetic container picking system
- Workpiece arrangement system with a Bin Picking Robot
- Basket wagon-to-conveyor box transfer system
- Transportation of a completed auto body with 2-ton payload super-large robot
- Maintenance, safety, simulation functions

**ROBOMACHINE**

**ROBODRILL**
- High-efficiency machining of steel and aluminum parts

**ROBOSHOT**
- Precision and stable molding of connectors and automotive parts

**ROBOCUT**
- High-speed and high-precision die cutting of thick workpieces

**ROBONANO**
- Ultra precision nano machine with improved ease of use and operation rate
New product: New HMI provides consistent support for machining operations

The New HMI is FANUC’s new user interface that is common to all machines and which provides consistent support for machining operations. It has an easy-to-understand screen configuration and uses graphical representations including intuitive icons and animations. The overall design of the new HMI, including the hardware, has been updated.

Supporting models: Series 30i/31i/32i-B

- The New HMI is based on efforts to improve the productivity of machining operations based on three phases: “plan,” “machining,” “improvement.” To consistently support these phases it is possible to access a variety of applications from the home screen.

To support the “improvement” phase in particular, we offer applications that take full advantage of FANUC’s knowledge, gained as a comprehensive manufacturer in FA.

- Plan --- Tool manager, Cycle time estimation
- Machining --- CNC operation screen, Machine collision avoidance
- Improvement --- Maintenance manager, Operation management

- The concept of the new CNC operation screen is “easy to use in programming, get-up and machining.” By consolidating the screen into the three items of “programming,” “set-up,” and “machining,” the usability has been greatly improved.

New product: FANUC FIBER LASER series achieves high-speed and high-precision processing

The FANUC FIBER LASER is a high-power FIBER LASER source applicable for cutting of metallic and non-metallic materials, welding, and additive manufacturing. Compatible operation with FANUC CO2 LASER series makes it possible to expand promptly your LASER processing machine lineup. This makes it possible to reduce the time required to develop new LASER processing machines.

Supporting models: Series 30i/31i-LB

- High-speed LASER command synchronized with axis control via FSSB connection realizes high-speed, high-precision processing.
- Attains an ease of use equivalent to that of CO2 LASER, making it possible to reduce the development period required for LASER processing machines.
- Capable of the stable output of LASER beams with a high-speed LASER command and the output feedback function. Offers a wealth of LASER control functions, including the minute LASER output control function, which is suitable for marking.
- Offers a wide variety of LASER processing functions, including: a processing condition setting function, which makes it easy to set up the LASER processing conditions, a power control function, which automatically changes the LASER output according to the speed, and a gap-control function.
New product: FANUC Robot ARC Mate 100iC/8L
As a new variation of the ARC Mate 100iC Series of popular arc welding robots, FANUC has developed a long arm type with a reach of 2 meters capable of welding large-size work pieces. This robot is already on sale. With the motion parameters optimized for arc welding and with an arm that has been significantly downsized from that of a conventional robot, the robot mass has been reduced by 40% and the radius of interference around the waist has been reduced by 20%, thereby making it possible to downsize a welding system. In addition, the power consumption has been reduced by 30%, thereby contributing to energy saving.

- The ARC Mate 100iC Series of robots are based on the ARC Mate 100iC/12 basic robot, modified by adding and changing arm parts as appropriate. With the addition of this new product, it is now possible to cover operating areas with a reach of 1.4 m to 2.0 m.
- Among the ARC Mate 100iC Series, the robot installation dimensions, the tool mounting interface, and the drives of every axis are common. All ARC Mate 100iC Series robots share the same tools and peripheral equipment, motors, reducers, gear drive systems, and even the same maintenance parts such as controllers and amplifiers.
- With its slim wrist with cables built in, and thanks to its unique gear-drive mechanism, the new robot can operate in cramped locations, such that welding can be done without the operator having to be concerned about any torch cable interference.
- The operating space in front of and behind the robot has been expanded to secure a horizontal stroke of 1.5 meters and a vertical stroke of 3.7 meters.

Ceiling and angle mounts are supported as standard.
- The ARC Mate 100iC Series of robots are renowned for their reliability, with more than 50,000 units having been shipped to date. With their high levels of reliability and flexibility, they enable the achievement of a welding system with high productivity.

New product: Zero down time (ZDT) - maintenance and diagnostic function
On a production line, a problem with a single robot can lead to an extended line stoppage, or what we call a "long production downtime." To prevent the occurrence of a long production downtime, "Predictable" preventive maintenance is important, with operators being informed of any abnormal situation before an alarm stop, or being prompted to perform maintenance beforehand.

The zero down time function helps to improve the robot operation rate, with functions that are useful to preventive maintenance:
- Mechanical Health
  - Reducer diagnosis, motor torque monitoring, servo alarm recording, etc.
- Process Health
  - Operating status, vision detection results, servo gun status monitoring, etc.
- System Health
  - Error information, memory usage, CPU and network load, etc.
- Maintenance Health
  - Grease change time, battery replacement time, lubrication of balancer bushings, etc.
Such information can be centralizedly managed on a server, and can be sent in real-time to remote devices such as smart phones. In addition to a robot-only configuration, it is also possible to select a configuration that is best suited for your environment, such as a cell-by-cell or factory-by-factory configuration. Furthermore, cloud support is now under consideration.
■ New feature FANUC ROBODRILL-LINK i
The FANUC ROBODRILL-LINK i is a PC software package for managing the operating status of ROBODRILLs installed in factories. It also enables to check the factory status in a remote location via the Internet.
- Capable of real-time monitoring of ROBODRILL operating status (running/stopping/alarming).
- Collects ROBODRILL operating status and the machining counts continuously, in order to improve sustainability.
- Collects and analyzes the ROBODRILL alarm history and CNC data for both the failure cause investigation and the preventive maintenance scheduling.

■ New feature FANUC ROBOSHOT-LINK i
The FANUC ROBOSHOT-LINK i is a PC software package for managing ROBOSHOT production and quality information. When combined with FANUC robots, new functions have been added that contribute to the improvement of productivity in molding operations.
- Capable of real-time monitoring of the operating status of ROBOSHOTs and FANUC robots.
- iRVision (FANUC robot built-in vision) provides real-time display and saving of molding images acquired during operation.
- Enables the batch management of ROBOSHOT molding data and molding image data, allowing you to achieve more advanced traceability.

■ New feature FANUC ROBOCUT-LINK i
The FANUC ROBOCUT-LINK i is a PC software package for managing ROBOCUT production and quality information. By monitoring the operating status and quality management of ROBOCUT, It contributes to the improvement of productivity.
- Capable of real-time monitoring of the operation status of ROBOCUTs. In addition, it can forward the status to a mobile phone, such that operators can be fully aware of the factory production status.
- The quality management function automatically records the machining status, and operators can check the machining quality by comparing the status with the data acquired during the machining of good parts.
- Easy-to-understand displays of alarms and wire break positions, helping operators investigate the cause of a machining failure.
We invited the following professors, who provide us with advice and support in our daily research work, to attend the FANUC Open House on April 17 (Friday) to view the products on display. The professors later took part in a round-table talk.

**Attendees**

Toshiro Higuchi  
Yoichi Hori  
Hideki Aoyama  
Keiichi Shirase  
Eiji Shimoto  
Masatoshi Ishikawa  
Shigeaki Sugano  
Ichiro Sakuma  
Takayuki Okatani  
Hideto Yoko  
Masanori Kunieda  
Tojiro Aoyama  
Professor at Tokyo University  
Professor at Tokyo University  
Professor at Keio University  
Professor at Kobe University  
Professor at Nagoya University  
Professor at Tokyo University  
Professor at Waseda University  
Professor at Tokyo University  
Professor at Tohoku University  
Professor at Tokyo University  
Chairperson of the Department of Mechanical Engineering, Keio University  
(in the order of speaking)

**FANUC Corporation**

Yoshiharu Inaba  
Hiroyuki Uchida  
Kiyonori Inaba  
Shunsuke Matsubara  
Hirosi Noda  
Hidehiro Miyajima  
Mitsuyuki Taniguchi  
Yuji Nishikawa  
Dong Zheng  
Satoshi Takatsugi  
Yui Takayama  
Hong Rongshao  
Masako Sudo  
Masahiro Morioka  
President and CEO  
General Manager, ROBOMACHINE Business Division  
General Manager, ROBOT Business Division  
General Manager, Research & Development Administration Division  
General Manager, CNC Hardware Laboratory  
General Manager, CNC Software Laboratory  
General Manager, SERVO Laboratory  
General Manager, LASER Laboratory  
General Manager, ROBODRILL Laboratory  
General Manager, ROBOSHOT Laboratory  
General Manager, ROBOCUT Laboratory  
General Manager, ROBONANO Research Department  
Chief Engineer  
General Manager, Collaborative Robot Development Division
President Inaba: Thank you very much for taking the time out of your busy schedule to attend FANUC's internal exhibition and participate in the round-table discussion today. Here at FANUC, we have pursued research and development and sales in the narrow field of automation and robotization for the manufacturing industry for about 60 years, from which our FA, ROBOT, and ROBOMACHINE businesses have grown. These businesses have been divided into three business divisions, and in each of these, product development and sales have been integrated, in an effort to ensure that reactions from the market can be fed back to research and development quickly, and that the development speed can be increased more and more. One and a half years have passed since then. I think that the results of our efforts can be seen in this internal exhibition. The two key phrases on which the exhibition is based are ‘one FANUC’ and ‘Service First.’ With ‘one FANUC,’ the three businesses of FA, ROBOT, and ROBOMACHINE, which have become independent in some respects, are brought together in others with the aim of offering products that will benefit customers from their synergistic effect. With the other key phrase of ‘Service First,’ we would like to achieve zero down time (ZDT). Customers use our products in production operations, so any down time is a major inconvenience to our customers. Rather than simply pursuing better performance, the latest technology, higher precision, higher speed, and so on, I think that service activities such as thinking how to reduce down time are very important, although they are very unglamorous activities that are apt to be forgotten. To that end, we are determined to proceed with development based on the concept of products being “Reliable, Predictable, and Easy to Repair.” Today, we’d like to divide the discussion into the FA, ROBOT, and ROBOMACHINE groups, and listen to your opinions on each group.

FA

President Inaba: I would like to start our discussion on the FA group by having Professor Higuchi talk about this topic. Professor Higuchi provides us with guidance in various subjects such as actuators and control.

Professor Higuchi: This year’s exhibits are quite different from last year’s. What I felt this year, as well as last year, is that they are easy to understand when I look at them. Previously, it was normal to sit through an explanation of such-and-such a product or function, after which we would begin to understand what it was used for. Last year, the exhibits were changed in that you placed the explanation of how they were used in front and explained that that was why you used such-and-such a technology. This year, there are many exhibits where you have put specific uses, requirements, and actual needs in front, and explain that such-and-such a technology is applied to them. I strongly felt that you have come to understand the requirements of the users, that is, those who actually use the products. There were quite a number of exhibits presented for the first time this year. Examples included SiC (power elements) and fiber lasers. One of the exhibits I found interesting was that which performs high-speed threading. Its control method is similar to that of the non-circular contour lathe machining that I once worked on. To create a contour with NC, it is common to issue commands for each of the X- and Y-axes from a computer to ensure the correct timing, but with non-circular contour lathe machining, an encoder is attached to the spindle to position the turning tool with reference to the rotation angle. When I looked at this exhibit, I was impressed to learn that you could also do such a thing. Furthermore, I was very amused to see the exhibit based on the concept of storing electricity using motors, without using capacitors or batteries. I remembered that NTT (the former Nippon Telegraph and Telephone Public Corporation) once conducted research into storing energy in rapidly rotating flywheels supported by magnetic bearings as an emergency power source in the event of a power failure. I thought that the device in this exhibition could be made more compact if the motor could rotate a little faster during energy regeneration and so on. The ROBONANO has improved immensely. Although applicable to milling and lathe systems, a milling system is on display here today. I felt that this was particularly good in that the stroke is long. There are many applications where there is a need to perform fine machining along a long stroke with high precision, so I felt that design would find many applications. The design has been refined. Was the operator’s panel wholly machined? The ROBONANO is where you incorporate a variety of new technologies, so I really hope that you continue in this direction. In this exhibition, I could see that you were trying to solve the needs and problems of users by various means, which is highly commendable. At the entrance to the exhibition site, I saw the slogan “Reliable/Predictable/Easy to Repair” (original slogan in Japanese: Unbreakable/Let’s you know before it breaks/ Can be repaired immediately if it does break). The English and Chinese versions give the impression that the machine might fail slightly rather than breaking outright. When we say that something ‘breaks’ in Japanese, it gives us a violent impression of something being destroyed, so I think that this level of expression is right for Japanese people. For the manufacture of semiconductor devices that must never stop, for example, employees of the (device and machine) distributors reside at the facility to provide maintenance. I think, however, that rather than residing at the production facility, they should get information in the most convenient way possible, detect problems before they happen, and take appropriate action. This is an important issue, so I would like you to continue to work on this in the future.

President Inaba: Thank you very much. We have been striving to conduct development and product commercialization from the customers’ perspective, providing explanations from the customers’ perspective, so we are very glad to hear your comments. Again, thank you very much.

President Inaba: Next, Professor Hori, who provides us with great assistance in the area of electricity.

Professor Hori: Thank you very much for inviting me again this year. I will turn 60 in July of this year. I think I’ll get a Swiss MONDAINE watch from the alumni as a present. Clocks made by this manufacturer can be found at Swiss Railway stations, and their movements are very interesting: The second hand makes one rotation in 58.5 seconds, takes a rest for the remaining 1.5 seconds while pointed directly upwards, and then the minute hand advances by one. I was interested to know why this was so, and therefore asked Professor Sone. He replied, “The Swiss dare to do something difficult to do like that,” which made me think a little. After all, what is important is to steadily undertake those tasks that are to be done. I think that, in this respect, FANUC has always taken the high
Professor Hori: Thank you very much.

President Inaba: Next, let’s hear from Professor Hideki Aoyama, who provides us guidance in the areas of dies, CAD/CAM, and cutting.

Professor Hideki Aoyama: I saw the slogan, “Reliable/Predictable/Easy to Repair,” which made me think that it would be wonderful if such machines actually existed. I feel like suggesting that, because FANUC develops a huge range of products from CNCs to servos, the company should aim higher, producing more advanced products and then integrating them together while, at the same time, aiming for the development of technologies that are consistent from upstream to downstream. I mean, wouldn’t it be possible that you team up with upstream and downstream companies to create a system that can be implemented throughout Japan? I think that it will be necessary to improve the performance of servos or CNCs and, at the same time, technologies for creating CAM data suited for servos and technologies for accurately simulating servos will be necessary, among others. I think that, at present, CAM companies and servo companies develop systems independently of one another, complementing one another, but I think that if they could exchange information with one another, the result would be more advanced products.

Next, I’d like to talk a little more about the individual exhibits that stand out in my memory, in the order that I recall them. For the HMI (user interface), which I saw first, I think that, in the machining part of “planning, machining, improvement,” those locations on which you have been working have become more advanced, but I think that it would be preferable if improvements could be made to more advanced systems. At present, the system is such that servo information is displayed, and the operator is requested to respond to it. You are currently in a position where servo information can be used, so I got the impression that, if there were a system that could make improvements to the data, that, at present, CNC companies and servo companies develop systems independently of one another, but if they could exchange information with one another, the result would be more advanced products.

For industry, so we are like Galapagos. Outside of Japan, 400 V is much more common. What direction will Japan take in the future? I think that for SiC, it should be 400 V, naturally.

Professor Hori: I think that we should unify power to 400 V for industrial use and 200 V for home use, with a frequency of 60 Hz. Is this so difficult to do? One possible way of doing this would be to introduce devices that can run on both 50 and 60 Hz and switch to 60 Hz at a certain point in time. This is not an outlandish idea. We should think about it seriously.

President Inaba: Thank you very much.

Professor Hori: In Japan, 200 V is mainly used for industry, so we are like Galapagos. Outside of Japan, 400 V is much more common. What direction will Japan take in the future? I think that for SiC, it should be 400 V, naturally.

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President Inaba: Thank you very much.
displayed on the "Servo Viewer," which will be incredibly useful for them and they can think of good ways to use it. Machine tool manufacturers must, however, be aware that the performance of their machines is exposed entirely. I'd like to pay attention to how things will change in the future. Another exhibit I'd like to mention is the system for feeding back data to a higher level, using servo information. Advanced users will find this very useful. But, what counts is what to do after receiving data. I think that, if you give users servo information, they should be able to make their machine tools into really advanced versions and use controllers, if you also provide them with tips as to how to process the data, the type of information into which to convert it, and how to apply it to machining or to the management of machines. Another thing I was interested in was 'gain filter auto adjustment.' I learned that this function was for machine tool manufacturers to adjust the gain, but I thought that users would be more likely to use it than the manufacturers. Naturally, a machine tool is shipped after undergoing gain adjustment, and I don't think that the gain will change normally, but I do think that, for a rotation axis, the optimum gain will change considerably with a mere change in the material weight, and I think that the gain is influenced with a mere change in the feedrate. I think that, if users are allowed to perform dynamic gain adjustment, the machining precision will increase and the speed will increase, also. At my laboratory, we conduct simulations to determine the optimum gain by modeling machine tools. We have begun to realize that, even for a linear axis, both the gain and trajectory of motion differ depending on the weight of the material to be placed, either 100 or 500 kilograms. At the stage where NC programs are prepared, preparatory simulations are conducted to set the gain for each NC program, based on the machine tool model, using MATLAB/Simulink. How is it possible to reflect the results in the programs dynamically to attain a motion? I think that, if that could be automated, then it would be possible to attain high-precision machining. For a rotary table, in particular, this will not make any difference as long as the center of gravity of the material matches the rotation axis, but the minimum gain will differ completely if it gets out of position only slightly. For this reason, I think it's convenient if the user can determine the optimum gain by pressing the gain filter button after placing the material.

President Inaba: Thank you very much for your valuable comments.

President Inaba: Next, I'd like to hear from Professor Shirase.

Professor Shirase: You have this slogan, "Reliable/Predictable/Easy to Repair." I get the impression that you are developing products that have very high levels of perfection, that users can readily use, and which will delight the users by their mere existence.

By the way, I once pointed out to President Inaba, "Why do you dispose of CAD information without using it?" FANUC has a high degree of perfection in terms of how to operate machine tools with high efficiency and high precision by faithfully following NC programs. But, I think that you unnecessarily make problems for yourselves because CAD shape information cannot be received. I do hope that you will strive to try to let machine tools receive more CAD information and put it to good use, in an attempt to aim for higher precision and higher efficiency. In so doing, just like Professor Aoyama pointed out, if you cover everything from the upstream CAD/CAM to the downstream NC, you need to consider whether to do so on your own or to team up with other companies. At present, it has become possible to collect information by connecting various sensors and accumulate large amounts of data resulting from status monitoring. One future issue will be how to analyze and utilize such information and data. If data can be "visualized," then an operative would be able to implement an action, so this would be very effective. There are, however, where the workers are not so enthusiastic. So, I think that, as the next step, it will be necessary to analyze, evaluate, and show the accumulated data. In the section on 'smart rigid tapping technology,' I saw an exhibit where the spindle is given top priority to rotate the tap, and the feed motion is matched with the rotation of the spindle. From the standpoint of the machine tool, this is favorable because it can exert its performance very well, but for the tap, the machining is demanding, and I worry whether tap breakage would be an issue. There is, therefore, a need for a system for avoiding this. This leads us to the question: 'How can we determine the machining status?' We are interested in how far the spindle load and load meter information from the "Servo Viewer" can be used for control. For CAD/CAM and machine tools, the roles have been divided so far, and it's considered appropriate for a machine tool to operate by faithfully following an NC program created on CAM, but I doubt if this is the best. Each machine tool has its own characteristics, differs in structure, and its motion varies widely depending on where the work piece is placed. So, it presents problems if different machine tools, which differ in their characteristics, are all run using the same program. Assuming that there is CAD data for products, and that the machining processes and tools have been determined, I think that the number of machine tool motions suitable to them must be equal to the number of characteristics of the machine tools. We are currently performing research into this subject. We are also looking into means of reducing the energy consumption of machine tools. For a car, the fuel efficiency varies depending on how you drive it, but it is not known how effective for energy consumption reduction of machine tools it is to operate them properly. We are working not only with NC but also with CAD/CAM in an attempt to determine the energy saving that can be attained by thinking of good ways to perform machining in accordance with the characteristics of the machine tools. I do hope that FANUC will also work on the development of NC units that differ from those which are currently available, through the control of the machine tool, the control of the machining processes, and the linkage with CAD/CAM.

President Inaba: Thank you very much. We also believe that NC machining by using CAD/CAM information is a very useful concept, especially for the machining of 3D free-form surfaces. We hope to work on this in the future. Energy-saving operation has already been achieved for some robot products. Research has begun to determine, for example, how an optimum process should be supplied to achieve a balance between cycle time and energy consumption. Our hope is to apply the results to machine tools soon.
President Inaba: Next, we’d like to hear from Professor Shamoto, who has tremendous knowledge about cutting.

Professor Shamoto: Last year, when I took a factory tour, I saw robots created at one FANUC factory and motors at another FANUC factory. After learning that you avoid manufacturing overseas and continue monozukuri in Japan, I felt that I’d like to see such companies increase in number, and I’d like to see companies become part of the culture of Japan.

This year, I was very impressed by the new ROBONANO first. The design has improved, and I think it has turned into a machine that is not only very compact but also actually easy to use. I do hope that you continue to refine it to the point where it becomes a machine that can beat its overseas competitors. I think that it is laudable that you have set the resolution to 0.1 nanometers with the aim of differentiating yourselves in terms of the control system. At the same time, I was very surprised at the advances in HRV control. I felt that you were going to achieve high precision from ordinary machines, based on the ROBONANO ultra-precision machine. As an example, I saw the results of achieving near-mirror finish machining with a ROBODRILL, and I felt that there is great potential for the spread of high-precision machining in the future.

For the past few years, machine element technology, tool technology, and machining technology have improved, and I think the era is approaching in which near-mirror finish, high-precision machining is possible with ordinary machining centers. Today, I feel that NC technology is also approaching this stage. More specifically, I learned about the HRV3.4, which realizes high-precision machining. The SiC element has also led to major improvements. The SiC element improves the chopper frequency little by little, which leads to the ability to increase the control gain, thereby realizing high-precision motion by suppressing variations in the speed. I feel that FANUC is really strong in that you have accumulated these basic technologies and are steadily building on them. I have a feeling that the strength of Japanese companies lies here. Other than that, I learned that you use motor torque fully and that you have increased the operating voltage to achieve downsizing. As a result of both of these approaches, the performance has increased little by little, which I feel is cumulative. For the future, as I mentioned last year, I hope that you will strive to take even machining processes into consideration, make guesses, and provide feedback in accordance with the results, so that you can take appropriate corrective actions when necessary.

Recently, a considerable number of functions have been made available for suppressing chatter. It is necessary to not only run machines but also consider that there are processes, force is applied to cause deformation, generate heat, and cause vibration there. I feel that the interaction with processes will remain as the most difficult aspect facing the development of machine tools. Looking at this from the opposite perspective, I think that this is where you can differentiate yourselves in terms of technology. Finally, here is my personal wish: A function called FTS is used in the ultra-precision machining field. If FANUC were to consider developing units capable of supporting this function, and performing fine cut-in control in accordance with the NC motion, we could supply them widely within our field. I really would like you to consider this.

President Inaba: Previous ROBONANOs pursued only champion data, while giving less consideration to ease of use and maintainability. To redress this, we are currently undertaking development by considering the achievement of performance first and placing emphasis on how we can improve ease of use and maintainability. I am very grateful to you for having evaluated this matter. We’d like to receive more comments and guidance from you again in the future. Thank you very much indeed.

ROBOT

President Inaba: Now, the next topic is ROBOT. Let’s hear from Professor Ishikawa, who provides us with guidance in high-speed vision.

Professor Ishikawa: The field of robots is now becoming popular worldwide, and our university receives many questions from people in the United States and elsewhere. These questions relate to the potential capabilities of robots, and they always end with the question, “What kind of company is FANUC?” I have to think of how to answer each time, but when I answer, ‘FANUC’s robots won’t break,’” the questioner understands.

To attain a zero down time, robots must not stop no matter what happens, but the robot I saw today was constantly stopping to apply vision-based sensing. By using a high-speed vision sensor that is compatible with the dynamics of the robot, sensing can be performed without stopping the robot, and because feedback is provided at that speed, I believe that it should be possible to control everything at those time intervals. I hope you have a strategy and the time needed to develop a reliable, unbreakable vision sensor. I think that the pattern projection during 3D measurement that I saw today is still too slow. We ourselves noticed this several years ago, and we have since set a goal of generating pattern projection at 1 ms. If pattern projection takes 1 ms, and vision takes 1 ms, then 3D shape measurement can be performed with a fairly high degree of precision in 1 ms to several ms. I really do hope that you can realize a system where the robot does not stop for vision sensing, with a vision sensor that manages to do its job even while the robot is operating.

I think it’s a good idea to think, “Vision is very useful for robots, but it can also be used with FA and ROBOMACHINES.” I have a feeling that it would be better to encourage FA members to use vision. To that end, we should promote the use of vision to FA members, and ask them to identify the needs of the people on the site. I think that, in this way, good combinations would emerge. Similarly, I think it’s better to decide how to use vision with a Collaborative Robot, in which humans are involved, by asking people on the site how they want to use vision. The Genkotsu-Robot is very fast, but I thought it could be made a little faster with a high-speed vision sensor, so my laboratory bought a single Genkotsu-Robot. Our intention is to operate the robot at high speed while using a high-speed vision sensor, and I look forward to being able to tell you about the outcome. When I think about the future, I imagine sensors and actuators that are constantly connected to a network. When I think about how to move sensor information and control information on a network, I don’t think there will be many

Professor Ishikawa
good networks in the near future. Considering reliability and the concept of not stopping the robot, general networks cannot be used because the worst value for the number of communication packets is infinite. There are modes in which the worst value is not infinite, but then, they have other restrictions. I think there will come a time when we have to think about how a network should be constructed to create a system in which the robot does not stop, while maintaining reliability. I expect that, before next year's exhibition, you will have developed a vision sensor that does not require the robot to stop and which does not stop itself.

**President Inaba:** Thank you very much for your positive comments. We also keenly feel the need for high-speed vision sensors, and we are currently working on this within the organization. I would like to ask you for your support and guidance regards this.

**President Inaba:** Next, let's hear from Professor Sugano, who is active in the field of sensing for collaborative robots and so on.

**Professor Sugano:** Someone used the words "steadily" and "accumulating" a while ago. I strongly feel that "accumulation" will arise from green robots. Although it is said to be rather difficult to realize a practical robot based on a new concept, one definitely accumulates efforts to put such a robot to practical use, which I think is one of the most wonderful aspects of the process. While the color has changed from deep green to light green, I'm afraid that the cover material hasn't changed from last year's. To increase the payload by considering the robot's use in the auto industry, the robot has become slightly larger than last year's model. I hope that even if you make the robot bigger, you will make it strong enough to continue running when it strikes something rather than stopping just when it comes in contact with it, if possible. Many companies are now addressing safety issues and collaboration. I think that, for Japanese robots to go one step ahead of those in the rest of the world, it is necessary to produce a robot that continues to run not only when it comes in contact with something but also even if it strikes it. To that end, all of the technologies related to cover materials, actuators, sensors, and so on must move toward a new development stage. I do hope that you become a challenger and work on new themes. I think that, if FANUC successfully puts a relatively small robot to practical use, which is capable of working on the site together with humans, and which continues to run even when it strikes an object, with a low level of risk, this will have a very large impact on the market, and will push the Japanese robot industry into a new era. In my laboratory, our research addresses robots that are assumed to strike an object and which remain unaffected, rather than attempting to avoid a collision. We constantly think of true "collaboration," whereby a robot can work together with humans in every respect, including the force of inertia, rather than simply stopping. What's more, I want to see you challenge the task of preparing not only the robot itself but also the environment in which the robot will operate, that is, environment structuring. For the area sensor you exhibited this year, you provided the environment side with a function that eliminates the need for a fence because the robot stops whenever a human approaches

and enters the area. If we change the environment surrounding the robot, by thinking of the vision sensor and other sensors and the ways to create the place for humans and the robot, as well as the related design theories, then it may be possible for the robot to approach humans more closely. It seems that there has not been much discussion about such development issues at robot manufacturers. Why are industrial robots widespread when collaborative robots for humans are not? Well, that's because a factory is made to make it easy to install robots, while a home is designed for humans, so it's hard to introduce robots. I think that, when we think of these matters together, we can create a design theory for an environment in which humans enter a factory and better collaborate with robots. I do hope that you will consider making the jump "steadily" from research aspects.

**President Inaba:** You mean we need more leaps, right? I'd like to work hard toward the future. Thank you very much for your comments.

**President Inaba:** Next, Professor Sakuma, whose research addresses medical robots and sensor technologies.

**Professor Sakuma:** I have been studying collaborative robots for humans from the viewpoint of medical robots, which is my specialization. I was very surprised to find that this field has taken shape so quickly. You address safety by assuming specific scenes, which is very important. I thought this was very good. There are some things that worried me, however. You gave an explanation stating that, when you think of safety, you provide double safety, for example. My question is, whether safety can be achieved with that alone. For the measures needed to achieve the safety of medical equipment, which is my specialization, it is natural to adopt engineering techniques, such as fail-safe systems with double sensors, but more important is risk management whereby we consider the situations in which the equipment is used, perform risk analysis, and implement appropriate safety measures. Some people say that, in the field of medical robots, it is very risky for a surgeon to use robots, and it may be easier to use them for rehabilitation. I think that the reality would be the other way around. Doctors are professionals, so you can predict to some degree what they will do. But, when you bring a robot into an ordinary home, it is very difficult to assume the risks that they will face, because the old men and women with whom they will interact will vary widely. If what has previously been performed by humans in a factory is to be performed with the cooperation of humans and robots, it is necessary to change the conditions, so we must consider a very wide variety of issues. It is thought that safety must be assured even in scenarios that differ from those that have been considered so far. Knowledge and experience gained on the site have very great significance in risk analysis, so I do hope that you address the issue of how to pay attention to safety in an environment where robots collaborate with humans, and propose measures to assure safety. And, in the approval review of the medical equipment with which I'm engaged, we constantly discuss the level of safety that can be assured at the stage of approving the medical equipment. Before approving medical equipment, we conduct a thorough investigation and analysis, but we recognize that if the equipment is
actually used widely, situations that could never be foreseen could arise. Thus, even after medical equipment becomes commercially available, its usage is continually investigated for a certain period of time, as well as whether it causes any problems, while what happens in the actual use environment is examined, so that safety measures can be implemented. For equipment with very high risks, we ask the manufacturer to investigate every possible usage scenario. I don’t think that it’s possible to force the investigation of every possible case in the field of robots, but when you actually let robots collaborate with humans, it is probable that situations that were not foreseen at the design stage will arise. I think it’s very important to think how to pick them up. Medical doctors often say, “Big data is almost always garbage,” but when you collect garbage data, you will find there are actually different types of data. The amount of data that can be collected has increased dramatically, but if you collect data in a conventional way, strange things tend to happen. In biological and physiological engineering, what is important for automatic diagnosis is the understanding of diseases. The same is true of robots. I think it’s very important to think how to model the understanding of work and work flows. Finally, Professor Hori talked about the “first-year seminar,” which has been started at Tokyo University. I am the Vice-Dean in charge of education in the School of Engineering, and I’d like to make some comments. The sense of the present elementary, junior high, and senior high school students toward real objects is somewhat similar to that when they see them on the Internet. I think that the intent of the first-year seminar is to show that there is a real world out there and that what the students can do with what they have studied is limited. Therefore, we must urge them to study at university voluntarily and steadily. How much we can do is one point facing the current reform.

President Inaba: Thank you very much. I do hope you will send those students who can recognize reality to FANUC. I have listened to your comments comparing medical sites with manufacturing sites, with great interest. We would also like to tackle risk analysis and risk management because we are new to the field of collaborative robots. We would very much like to ask for your guidance, therefore.

President Inaba: The last speaker for the ROBOT group is Professor Okaya, who is responsible for research into vision-related topics.

Professor Okaya: My responsibilities consist of research into software for vision technologies for robot vision sensors, computer vision sensors, and so on. After seeing the exhibition today, I felt that FANUC should make a little more investment into software technologies. There are two reasons for this. First, someone spoke a while ago about monitoring the operating status by attaching sensors and about advances in vision technologies. Boeing keeps its engines online to monitor their operating status and analyze big data. I think that it is possible to do similar things at FANUC, also. To do so, you will need so-called “data scientists,” who can implement statistical machine learning and analyze big data. The other reason is the recent abrupt progress in vision and other AI technologies. With the development of deep learning, in particular, technology that was not possible before is now possible with not only vision but also audio and language processing. Automatic voice recognition with a smartphone has improved dramatically by using a deep neural network. Recently, automatic translation services have come close to becoming practical, and the performance is said to be sufficient for translating children’s speech, although not 100% satisfactory. One recent outstanding advance in vision is that it is now possible to show an object to a computer and have the computer state what it is with a precision comparable to that of humans. Other than that, what has not been possible is now possible with a variety of technologies. For example, one research report has stated that when video images of a video game are shown to a computer, and an evaluation function learned the score of the video game in such a way to maximize the score, this enabled the computer to operate the video game properly as a human. Now that it has become possible to do various things with AI, Professor Stephen Hawking says that if AI advances at this rate, it could be a threat to mankind. I myself think that it is a little excessive. For example, what AI can now do with vision is only a very small part of the capabilities of a human with his or her vision. For example, a computer would not do very well with scanning this table and answering where the plastic bottle is. There are many, many other things that humans can do with their vision but a computer cannot. So, I don’t think that AI technologies will reach human levels soon. That being said, it is a fact that computers are getting smarter and smarter. I think that the ultimate goal of robots is to take on the work of humans. Apart from vision technologies, it has gradually become possible for robots to learn the sequence of assembly work, for example, at the thesis level. I think that it is possible that these will ultimately become destructive technologies, in that they will greatly change the robot industry. Robots now suddenly become able to do things that they could not do before. So, I think that a major issue is how to pursue the research and development of robots. I’d like to add that AI research and development personnel are currently in great demand, making it very difficult to secure the necessary human resources.

President Inaba: Thank you very much for your in-depth comments about vision. You pointed out that we need to make a little more investment in software, and we too keenly feel that. We hope that you will send us many students. Our goal is to accept about twice as many students next year as we did this year.

President Inaba: Next, let’s move on to the ROBOMACHINE group. I’d like to start the discussion with Professor Yokoi. Professor Yokoi has provided us with assistance for many years in the development of ROBOSHOTs, mainly in the visualization project.

Professor Yokoi: President Inaba began by talking about “one FANUC.” I noticed that the corporate emblem has been changed. Does this symbolize a fusion of the three divisions? President Inaba: Exactly. It signifies that the three divisions, FA, ROBOT, and ROBOMACHINE, are moving together in the same direction toward the future.

Professor Yokoi: After I saw the exhibits, I felt that you gave us a
strong impression that you had been fused together, centering on FA. In the field of injection molding, which is my specialization, we can see a robot sit in front of a molding machine, with the two collaborating. Previously, the impression was that the two were placed side by side, rather than being fused or collaborating, but you have achieved an overall fusion and systematic fusion with the likes of "LINK-i," further promoting comprehensive function reinforcement including information management. This time, however, the new technologies are somewhat hidden. For example, in the exhibit of two-material molding, I think you have introduced new element technologies such as a second injection unit, but I felt that other important elements such as the additional axis control of the die rotary table were hidden. Also, a molding machine and a robot were coupled together, but the advantages of this were not emphasized well, which I felt was a shame. I think that demonstrations that make viewers think that they really should be using robots are particularly important for differentiating you from other companies. A very important issue facing manufacturers worldwide is how to form carbon fiber, continuous fiber, and glass fiber while suppressing damage. For ROBOSHOTs, you have already completed, to a high level, the element technologies for use in IT, and have introduced them widely. In the present exhibit, on the other hand, the demonstration focused on the molding of automotive parts, but in reality, the biggest issue with car-related molding is how to suppress damage to the continuous fiber. This area has seen many different approaches taken, such as making a hole at the center of a cylinder and feeding the continuous fiber through directly; feeding the fiber through a vent port; and combining preplasticators, not to mention the optimization of the screw design, while companies are competing to differentiate themselves. I think that, if you want to expand this to automotive parts, it would be better to master the technology quickly and think where to make a technological breakthrough. Regarding the molding of IT parts, the element technologies have generally been completed, so I think you have entered the next stage of completing the robot and systematization technologies. As for the slogan, "Reliable/Predictable/Easy to Repair," which has already been mentioned by others, I think this is reasonable, but for molding, there is another important point, specifically, "Don't break" the die. I think you should add this too.

President Inaba: Thank you very much for your very direct comments. We have begun to steer slightly towards automobile-related fields, but we simply cannot develop the technologies for implementing measures against damage to continuous fiber overnight. We ask for your continued guidance, therefore.

ROBOCUT

President Inaba: Next, let's hear from Professor Kunieda, who provides us with guidance mainly in the field of the ROBOCUT wire-cut electric discharge machines.

Professor Kunieda: I felt that you have made proposals for machining methods linked to the needs of the people on the site. At FANUC, you deal with CNC, robots, and machine tools, and what's more, for machine tools, you deal with everything from cutting, discharge, lasers, to injection molding. I felt you have the power to propose systems and methods for monozukuri in general. What I found particularly interesting about ROBOCUT is the unit rotating in water. The unit remains in the water, and can cut well and with high reliability. I thought you could perform die sinking by combining it with wire-cut electric discharge, rather than merely using it there. I think that the unit can be used to create a complex mold around both wire-cut electric discharge and die sinking. I feel that you did considerable basic research at the same time as putting effort into needs and applications. In today's exhibit, you machined a very tall workpiece with a fair degree of precision and with good straightness. I felt you did basic research, understood the discharge mechanism and that of the vibration and deflection of the wire. Every electric discharge machine manufacturer proposes machining steps and machining conditions for achieving desired shapes, but there are a considerable number of cases in which machining cannot be performed according to the proposed ones. In such cases, the user can't tell what to do or where to do it to obtain the desired shape. That's because there are just too many parameters to deal with. I'd like you to create a sample-based simulation because you need to understand the discharge mechanism. The force applied to the wire includes the explosion arising from the discharge, the expansion of air bubbles, an electrostatic force, an electromagnetic force, and the force from the fluid of the jet flow of the dielectric working fluid, and it is now possible to analyze it all. There is, however, something worrying called the discharge gap. This is related to the multiphase flow of gas and liquid, which changes both the viscosity and electric permittivity. Unless these physical property values are known, the results do not match the theoretical values at all. FANUC's electric discharge machine, on the other hand, has transparent doors, so you can clearly observe what's happening. I hope that you will check the observed results against the simulation results in order to optimize the simulations. For the dielectric working fluid, it is said that water allows a very high machining speed, while oil is good for finishing. Last year, my laboratory examined why water resulted in high speeds. With a single-shot discharge, water and oil were no different in status, but with continuous discharge, oil became unstable under harsh conditions, and was not usable. We learned that water, on the other hand, did not become unstable even under harsh conditions. Water is no good for the finishing process only, so I have a feeling that if we can understand that portion theoretically, we can do everything with water. When electric discharge machining is performed, the material melts with a snapping sound and some of it evaporates, although 90% of the molten portion solidifies and returns to its original state. I think that if we can do something about this, we can further increase the machining speed. It is said that electric discharge machining is slow, but I think that not only wire but also die sinking electric discharge machining will experience another breakthrough. I do hope you continue with your basic research.

President Inaba: Thank you very much for your comments and copious suggestions. I think that simulations are rather difficult to create, but we’d like to take on the challenge.

ROBONANO

President Inaba: The last speaker is Professor Tojiro Aoyama, who provides us with guidance mainly in the area of ROBONANOS.

Professor Tojiro Aoyama: At the exhibition site, I was
given very in-depth explanations, which were easier to understand than last year’s, and I found a lot of things that interested me very much. Regarding the ROBONANOs, which are the closest to my specialty, I felt that they had become much more accessible than their predecessors. At my university, the Central Service Facilities for Research has a cleanroom, where there is one ROBONANO. There are many others, but the availability rate of the ROBONANO is overwhelmingly high. There is one engineer there, who says that it is very hard to set it up, and the time during which machining is actually performed is about 10% of the total. I think that good results have been obtained, such as the improvement of damping due to the use of static oil pressure lubrication for the direct drive guide and the facilitation of creation due to the improvements made to design portions. I felt that they had evolved into machines that are easier to handle while maintaining or further improving the high precision and high performance required of ROBONANOs.

Using oil lubrication for the spindle would generate heat. I think it’s a good idea to apply air lubrication there and oil lubrication to the table guide, which has a relatively low sliding speed. I think that there are some portions that are adversely affected by the use of oil lubrication, including the seals, pulsating portions, and portions affected by the temperature of the oil supply system. I think that, if you could eliminate such portions, you could lower the manufacturing cost, which will provide more advantages to your business. Even relatively large workpieces with continuous bodies of very small parts requiring subnanometer machining precision are becoming the targets of ROBONANOs, so I think there will be greater need in the future. Even after you switch from static air pressure to static oil pressure, the friction in the drive is low, so I think that the impact of the disturbance force on the control system is large. It is thought that, by using this, it will be easy to estimate, from the control system signals, how a disturbance force such as a cutting force is acting. I thought that if you were to use control system signals, you could advance to a stage where the status during machining is monitored.

Another point that interested me was the new user-friendly interface. I think that the machine panel with touch panel input looks high-class and is good. I thought that, if you polished these aspects, you would make fairly easy-to-access subnano machine tools. I also saw the FA portions. One thing I noticed was that if you use a touch panel, it is possible for the touch panel to malfunction due to a touch error or noise. I thought that, unless you used a touch panel with high operational reliability, the operability might worsen and, as the case may be, input errors might occur. Another thing is the omakase (leave it to me) menu that satisfies the preferences of the user. Some users want to use a menu just the way it is, so I thought it would be better if you provided an option offering both functions. Overall, some questions arise, such as the rights to the machining information and the big data to be stored and accumulated in the controllers, as well as the legal management responsibility. In terms of education, I feel that universities need to consider the development of human resources that can contribute to the networking of production activities. If you have any opinions about the kinds of human resources you want in your company, for example, I’d like you to let us know.

President Inaba: Thank you very much for making effective use of the ROBONANO. You have given us comments on a wide range of topics, and as for ROBONANOs, we’d like to thoroughly pursue the ease of use, including the ease of set-up, so I would like to ask for your guidance. As for the touch panel, we use a pressure-sensitive type, not an electrostatic type, intentionally, to suppress touch errors. Mr. Noda can explain this.

Deputy General Manager Noda: What you may be aware of is the so-called electrostatic type, which is commonly used. This type uses glass. The type we use is called the resistive type, which has been around for a long time, as is the type which is sensitive to pressure. As you pointed out, an electrostatic type presents noise problems, and it can malfunction even with something as small as a fly landing on it, and is impossible to operate when it’s wet. I think that this is an area where we must always consider reliability.

President Inaba: Our units are used on production sites, so I think that reliability is top priority. Thank you very much for giving us your comments and suggestions for an extended period of time.

FANUC's New Corporate Emblem

As of April 1, 2015, FANUC’s corporate emblem has been updated. The new corporate emblem signifies our strong determination, described below.

The three business divisions, FA, ROBOT, and ROBOMACHINE, are unified and all proceed in the same direction, toward a bright future for monozukuri.

FANUC will support monozukuri around the world, with concerted efforts, constantly keeping in mind the positive attitude woven into this new corporate emblem.

This emblem will be used widely for events and documents in the future.
Highly automated Servo Motor Factory

The Servo Motor Factory has a total floor area of about 80,000 m², with a manufacturing capacity of 125,000 servo motors a month. This is the latest robotized factory where FANUC's technologies are combined. By introducing intelligent robots equipped with vision sensors and force sensors, all of the processes have been automated, ranging from winding, stator assembly, painting, rotor assembly, balance correction, final assembly, testing, and packing.

Also, by using the auto warehouse not only for the storage of parts and finished products but also as a device for feeding parts to automated assembly cells, the highly efficient automation of in-plant logistics is realized.
President Inaba received the 2015 Eli Whitney Productivity award from the Society of Manufacturing Engineers (SME), and on June 1 (Mon.), the awards ceremony was held in Detroit, Michigan, U.S.A. The Eli Whitney Productivity award is presented to people who have made major achievements that have contributed to major productivity improvements. President Inaba is the fourth Japanese to win the award.

On April 1 (Wed.), the initiation ceremony was held in the hall at our headquarters. On this day, 140 new employees became new members of FANUC.

On June 17 (Wed.) and 18 (Thu.), a "technical explanatory meeting" was held at the Nagoya Branch, with the collaboration of the three business divisions, that is, FA, ROBOT, and ROBOMACHINE, under the principle of "one FANUC." In addition to various functions related to the improvement of the availability rate, exhibits that provide new tips for automation, such as Collaborative Robots, were received very well, attracting more than 1,800 customers in a two-day period.
Okamotogiken Co., Ltd.

Okamotogiken Co., Ltd. is engaged in the machining of a variety of parts, such as precision parts for sports bicycles and parts for high-class fishing equipment. We visited the headquarters factory located in Sakai city, Osaka, where we were granted an interview. At present, the company employs a large number of FANUC ROBODRILLs and robots to manufacture high-performance and high-quality metal parts.

Tell us about the products manufactured at Okamotogiken, as well as the characteristics of your company.

Chairman Ohara: The main products machined by us include bicycle parts like cranks, gears, brakes, and transmission parts, and the reel parts of fishing equipment. One characteristic of our company is that we internally manufacture our jigs and even undertake the management of our electrical systems. If we were to outsource the manufacture of jigs, it would take several weeks, but with internal manufacture, we can create even fairly elaborate jigs in a week or so. Even if we receive urgent work from a customer, we can start up mass production a minimum of about three days after acquiring drawings. At present, the turnover of products is fast, and products are switched to newer versions every three to four months. To accommodate this speed, we have proceeded with automation, with the introduction of robots, for example.

President Ohara: Since last year, we have been carrying out our activities by setting the principle, “Find +1.” Each and every employee sets a goal like a growth of +1 and a streamlining of +1, with the aim of increasing our organizational power to improve the delivery date and quality.

Tell us why you started to use FANUC ROBODRILLs, and what do you think about them now that you have been using them for some time.

Chairman Ohara: Since 2000, we have been receiving an increasing number of requests for machining 3D shapes, and we learned to create machining programs from CAD-CAM. Up until that point, we used the machine tools from other companies, but they were unable to keep up with the operating speed of the 3D shape machining programs, so we started to introduce ROBODRILLS. ROBODRILLs offer a look-ahead function, enabling us to achieve good machining surfaces, and the movement was smooth. We are selecting ROBODRILLs because they support G codes and others and offer a good balance between performance and price.

Section chief Ohara: ROBODRILLs are equipped with good performance controls, and are easy to use.

Assistant manager Ono: At present, we use 161 ROBODRILLs, and besides them, we have another 238 machine tools, including complex machines, more than 90% of which are fitted with FANUC CNC units.

You say that you are moving ahead with automation. Could you tell us your future prospects, and any requests that you may have for FANUC?

Chairman Ohara: We are thinking of the internal manufacture of robot systems, within this year, so that we can provide smooth and speedy support to mass production, using robots. We currently use 24 robots in combination with ROBODRILLs, and we are planning to proceed with automation by increasing their number. Even if we increase the number of personnel for an abrupt production increase, it takes several months to train them, and besides, working long hours has been out of place in the modern age. By applying robots, we should be able to start mass production in two to three weeks.
To that end, we would appreciate it if you could increase the number of courses and provide courses nearby. At the FANUC School, the courses are almost always booked. When we proceed with robotization, we must think of what to do if they go down. FANUC’s service staff reach us quickly, but it is important that you offer a level of ease of use that allows us to recover the robots easily by ourselves when they are down.

Assistant manager Ono: We are looking forward to the launch of new ROBODRILL models, although there are none scheduled for this year. (Interviewed by Kyoko Takatsugi, Manager of the Public Relations and Advertisement Department)

FANUC’s forest is at its colorful best!
In this issue, we introduce plants that produce small flowers quietly in the forest in early summer.

■ Helwingia japonica  
(photograph taken by Ashiike Pond on May 20)
At the center of each green leaf, a tiny light green flower is produced. After the flowers, the plant produces black round edible berries.

■ Maianthemum dilatatum  
(photograph taken around the Geihin-kan on May 27)
We encountered a habitat for Maianthemum dilatatum. The plant produces lovely round flowers that look like white fireworks with stamens extending from them.

■ Cephalanthera longibracteata  
(photograph taken by the robot assembly factory on May 27)
This plant, standing upright in the softly lit forest, is always impressive.

OKAMOTO GIKEN CO., LTD. (http://okamotogiken.jp)
- Established: August 1984
- Capital: 40 million yen
- Chairman and representative director: Yuichi Ohara
- President and representative director: Masahiro Ohara
- Address: 3916, Hinoo, Minami-ku, Sakai city, Osaka, 590-0142
- Phone: 072-273-7300
- Fax: 072-273-7310
- Number of employees: 136

Four Seasons of FANUC

FANUC’s forest is at its colorful best!
In this issue, we introduce plants that produce small flowers quietly in the forest in early summer.
The three business divisions, FA, ROBOT, and ROBOMACHINE, are unified with SERVICES as "one FANUC," to provide innovation and reassurance to manufacturing sites around the world.

The new "one FANUC" symbol stands for FANUC's spirit and determination.