The International Robot Exhibition was held for four days from December 2 (Wednesday) through 5 (Saturday), 2015 at Tokyo Big Sight.

We exhibited FANUC’s cutting-edge technologies by using systems for practical applications, such as collaborative robots, a super heavy payload robot and machine learning systems.

We also introduced the “one FANUC”, “Service First” initiative regarding factory automation (FA), robots and robomachines.

Consequently, the FANUC booth was busy with many visitors throughout the four-day exhibition period.

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**Collaborative robot area**

The world’s first 35kg collaborative robot attracted many visitors.

Demonstrating the high-sensitivity, contact-stop function of a compact collaborative robot, displayed in public for the first time.

Diverse applications using a compact collaborative robot attracted many visitors.

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**Super heavy payload robot area**

A super heavy payload robot lifting a vehicle high with zero wobble, catching the attention of many visitors

Demonstrating high-speed, high-precision, dexterous movements by using applications from the electronics, machinery and pharmaceutical industries

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**Learning spot welding robot area and arc welding robot area**

Reducing cycle time by applying learning functions to handling and spot welding movements

Demonstrating the vibration control of a large spot welding gun with a vibration control learning function

Arc welding robot with more choices of power sources
FANUC Global Partner Reception 2015 was held on the night of December 3 (Thursday). We invited 100 global partners selling FANUC robots to participate in the reception from Japan and other countries. Trophies were awarded to 23 companies as a token of our gratitude for their daily sales activities. The Grand Award was awarded to US-based ACME and Special Awards went to Yutaka Electronics Industry Company Ltd. and Daido Corporation.

The wonderful reception provided us with a sense of unity with our global partners and made us feel their enthusiasm for sales in the future.
New product: FANUC PANEL \( i \)

FANUC PANEL \( i \) is a display unit with integrated personal computer functions that is highly reliable even in an FA environment. You can create sophisticated personal computer functions that support the Windows Embedded Standard by connecting a PANEL \( i \) to a CNC. You can also use a variety of off-the-shelf Windows applications. The PANEL \( i \) now uses an Intel\textsuperscript{®} fourth-generation Core\textsuperscript{™} i processor. This processor enables more advanced screen displays and processing than the previous Intel\textsuperscript{®} Core\textsuperscript{™}2 Duo processor.

- The personal computer functions enable machine tool builders to easily create unique functions, flexibly addressing requests from individual customers.
- You can make machine tools more intelligent and support the IoT by using the graphical user interface, network function, database, and support for peripheral devices of the personal computer.
- The lineup includes 10.4”, 15”, and 19” LCDs (with touch panel and \( i \)HMI support).

New feature and new product: \( i \) HMI measurement function that significantly reduces the set-up and inspection time

FANUC \( i \)HMI is a user interface that consistently supports tasks in the workshop. \( i \)HMI now has a measurement function that reduces the set-up time before processing and the inspection time after processing. You can easily perform centering, offset measurement, and on-machine measurement from the dedicated screen. Because we developed an interface unit to which you can easily attach touch probes after purchase of machine without bothering machine tool builders, you can use the measurement function with little effort.

New product: FANUC SERVO AMPLIFIER \( \beta \)\( i \)SVSP-B series with high reliability and cost effectiveness

FANUC SERVO AMPLIFIER \( \beta \)\( i \)SVSP-B series is the all-in-one servo amplifier with three servo axes and one spindle axis. The small and medium capacity models of FANUC SERVO AMPLIFIER \( \beta \)\( i \)SVSP-B series become smaller than our conventional models by 30% (from 260 mm to 180 mm in width). These new models contribute to the size reduction of the electrical cabinet of machine tools.

- The size has been reduced by 30% from conventional models (7.5 kW and 11 kW models).
- Quick maintenance of the fan motor for cooling amplifier is possible from the front side.
- Trouble Diagnosis Function allows you to easily locate the failed part if an alarm occurs.
- Smart Rigid Tapping and Smart Spindle Acc/Dec are supported.
- The safety shut-off function (STO) eliminates the need for an external magnetic contactor.
- 200 V and 400 V power supply specifications are supported.
- Can be seamlessly connected with the \( 0i \)-F and 30\( i \)-B series CNC.

FANUC developed and launched the R-2000iC/270F with a significantly enhanced payload capability and the R-2000iC/210L, which combines a high payload capability with a wide operating space, as new variations of its representative robot product, the R-2000iC Series. The R-2000iC Series is an all-around intelligent robot with high reliability and production efficiency that can now provide superior performance in many more situations.

- The R-2000iC/270F is a robot with a payload of 270 kg. Although it took a large robot to handle heavy payloads that weigh more than 200 kg in the past, now the slim and compact R-2000iC Series can do it. The R-2000iC/270F helps with process automation including transfer and assembly of heavy payloads in a cramped, crowded workspace.
- The R-2000iC/210L combines a high payload capability and a large operating range with a payload of 210 kg and the maximum reach of 3.1 m. The R-2000iC/210L can be used to transfer long parts such as auto body panels or large panes of glass, for instance.
- Robots are increasingly used for high precision processing in the aircraft industry and new bonding technologies in the auto industry in line with the advancement of manufacturing automation. To hold tools and directly process parts, robots must have a high rigidity so that the tool does not shift out of place, even with the counterforce from processing, as it would lower the machine accuracy. FANUC successfully improved the rigidity of the R-2000iC/270F and R-2000iC/210L by 30% by leveraging the latest mechanism element technologies and servo technologies. They also contribute to automation in manufacturing processes such as riveting, drilling, and friction stir welding.

New feature: iRVision learning pattern matching

The new learning pattern matching has been added to the pattern matching function, which plays the central role in the integrated vision mechanism of FANUC robots, iRVision. The shape of the workpiece to be detected is taught as the model for pattern matching. That model is then optimized through "learning."

The model originally taught to the system is fine-tuned through the learning process described below based on the results of detection repeatedly performed many times.

- The irrelevant features of a model are deleted (top right photo).
- If the shape of the target workpiece varies as in the casting example in the bottom right photo, the features are changed to the average shape of the target workpiece. (See the illustration below.)

This fine tuning increases the score value at detection, further stabilizing it. The learning process can be easily performed by following the on-screen wizard format instructions. This means that anyone can easily tune the model in the same way as a skilled operator used to do based on his past experience.
Introduction of New Products and New Features (ROBOMACHINE)

New product: Machining system with enhanced usability and operating rate, ROBONANO

The new ROBONANO machining system model, ROBONANO α-NMiA, is a nanomachining system that leverages CNC, servo control, and hydrostatic bearings from FANUC to realize commands and control in units of 0.1 nm. Designed focusing not only on performance but with special attention given to usability, reliability, and maintainability, this product is suitable for the following mass-production markets.

- Auto market: Molds of head lamps and head-up displays
- Watch market: Molds of high-grade watches, finishing of parts without polishing, and decorative processing

(1) Highly reliable and highly rigid hydrostatic bearing
- Our highly reliable and highly rigid bearing is realized by applying a unique hydrostatic bearing to the linear axis and index axis.
- The damping effect of hydraulic oil suppresses minute vibrations and makes the most of the capability of highly responsive servo control.
- Because of the lubricating effect of the hydraulic oil, this highly reliable hydrostatic bearing prevents gouging even in the event of unexpected power loss.

(2) Further enhancement of processing precision and quality
- FANUC's latest and greatest CNC technology is employed to realize program commands in units of 0.1 nm and ultrahigh precision interpolation.
- Ultrahigh precision servo control is performed precisely following the interpolation command with SERVO HRV4 Control and ultrahigh resolution feedback.
- This is ideal for processing ultra precision molds, which need both high precision on the 0.1 nm level and high quality, and allows for finishing without polishing.

(3) Nano machine tool with good usability for mass production
- Usability has been significantly improved as the cumbersome and time-intensive set-up process was shortened.
- Operability has been significantly improved as the peripheral devices essential to ultra precision machining can be now checked on the screen specially designed for ROBONANO.
- The system working with the FANUC intelligent robot enables the robot to change workpieces and perform other tasks for mass production processing.
**CNC factory leveraging intelligent robots**

Our CNC factory has the capability to manufacture 25,000 CNC units and robot controllers every month. On the automation line, many FANUC intelligent robots are used for assembly and tests that only human beings were able to perform in the past.

The FANUC integrated vision known as iRVision and the force sensor are used in the assembly process to insert printed circuit boards and connect FPC cable connectors. iRVision checks and corrects the position of connectors and reliably connects them, controlling the force using the force sensor to not damage the printed circuit boards or the connectors.

In the test process, assembled CNC units go through continuous burn-in in the high-temperature test room and the automatic tester performs the final function test. Because the robot on the rail automatically transfers units between processes, the tests are performed unattended by any workers, not only at night, but also during non-business days. iRVision reads the two-dimensional identification code printed on the CNC unit and links it with manufacturing information such as assembly and test history for quality improvement and traceability after shipment.
Green Collaborative Robot  FANUC Robot CR-35iA
Winner of the 2015 (58th) Nikkan Kogyo Shimbun Ten Great New Products Awards Masuda Award
Winner of the 2015 Nikkei Outstanding Product and Service Awards Highest Award

The Ten Great New Products Awards are awarded by Nikkan Kogyo Shimbun Ltd. to products developed or commercialized during the award year that support the development of manufacturing industries and improve the international competitiveness of Japan. The awards ceremony was held on January 27 (Wednesday) at Hotel Grand Palace, where President Imizu of Nikkan Kogyo Shimbun Ltd. awarded an award certificate and a plaque to President Inaba of FANUC.

The Nikkei Outstanding Product and Service Awards are awarded by Nikkei Inc. once a year to outstanding new products and services. The awards ceremony was held on February 3 (Wednesday) at the Imperial Hotel Tokyo, where President Okada of Nikkei Inc. awarded a certificate and a bronze statue to President Inaba of FANUC.

Award winner  FANUC Robot CR-35iA

The FANUC Robot CR-35iA is the world’s first 35kg payload collaborative robot. The robot is capable of working in collaboration with humans without a safety guard to improve the operational efficiency and automation rate in various operations, including transportation of heavy parts and parts assembly. The CR-35iA collaborative robot, a crucial tool for manufacturing innovation, opens the door to a new era of automation.

Features:
1) The safety feature developed by FANUC enables humans and robots to work together without safety guards. This feature makes it possible to introduce robots into various manufacturing operations that have been conducted mainly by humans without being concerned about where to install safety guards.
2) Thanks to FANUC’s own sensor software safety feature, the robot stops safely when it comes in contact with a human. This feature meets the high level safety requirements of safety category 3/PL d and has obtained safety certification that ensures compliance with the ISO 10218-1 international standard.
3) Under the distinctive green jacket identifying collaborative robot is the same yellow robot as our other robots, maintaining high reliability and providing the latest intelligence features.
At the end of November 2015, the total number of robots produced by FANUC exceeded 400,000. Since the mass-shipment of robots started in 1977, yellow robots equipped with FANUC’s high-performance, high-reliability controller and servo technologies developed through the FA business have contributed to automating and robotizing manufacturing processes throughout the world. Over the 38 years since then, customers have continued to choose our products, making our company the first to produce a total of over 400,000 industrial robots. In addition to the R-2000i series, which holds the record as the most-shipped FANUC robot, and the LR Mate 200iD series for general industries that is popular among users, we also provide a rich lineup of products, including the latest model, the green robot CR-35iA that can collaborate with humans, to continue to contribute to automating manufacturing.

At the end of February 2016, the total number of ROBOSHOTs produced by FANUC exceeded 50,000. Since we made the first shipment of mass-produced, fully automatic injection molders (Autoshots) in 1985, our products have been highly recognized by customers for their precise stability, cleanliness, quietness and energy-saving performance and have been used in the manufacture of lenses and other high value-added products. In 1993, we released the ROBOSHOT series that used digital servo systems instead of conventional analog systems, thereby improving thin packing performance and cycle performance. This ROBOSHOT series also improved the compatibility of connectors and other high-precision parts with high cycle molding, thereby rapidly increasing the number of products sold to a total of over 50,000.

In the future, we will advance the “one FANUC” initiative (for integrating the capabilities of FANUC). For example, proposing practical molding systems that combine ROBOSHOTs and FANUC robots, promoting the use of artificial intelligence supported by machine learning and implementing IoT and various other network programs, thereby contributing to the further development of manufacturing around the world.
Watanabe Corporation provides wire electric discharge machining services at its processing centers in Fukushima, Kanagawa and Aichi. We visited the company's Chubu Wire-processing Center in Toyokawa City, Aichi Prefecture to interview President Watanabe, Mr. Sato, Center Director and Mr. Ueno, Deputy Center Director. Watanabe Corporation is using a total of 51 FANUC ROBOCUTs for wire electric discharge machining, 23 of which are used at the Chubu Wire-processing Center.

Could you tell us about your company’s business?
President Watanabe: My father started our company, which was originally selling press tools. After I joined the company, partly as a result of trial-and-error attempts to survive the economic recession in the molding industry, the company became more and more focused on wire electric discharge machining. Subsequently, in the process of recovering from the Lehman crisis in 2008, we shifted our business entirely to wire electric discharge machining. We are currently engaged in the business of delivering products that are processed entirely within our company to fulfill customers' orders for wire electric discharge machining. The company has a history of over 40 years since my father founded it, but it has been engaged in the current business for about 10 years. We branched out into the Chubu region in April 2011 after the Great East Japan Earthquake. Before then, we had been operating at two factories in Fukushima and Kanagawa. The Fukushima factory was not included in the evacuation area. However, it is in Nihonmatsu City, 50 km from the Fukushima Daiichi Nuclear Power Station, where the government rescue headquarters was established during the disaster. Areas around the factory were filled with evacuees after the earthquake and highways were closed, with all traffic stopped. Under the circumstances, in which the explosion of the reactor core of the Fukushima Daiichi Nuclear Power Station would force everyone to evacuate, we had no choice but to ask employees to stay in their homes. The remaining Kanagawa factory was under a planned power outage. Wire electric discharge machining accounts for three-fourths of our business operations. And since we had no electricity, we were faced with the need to take quick action.

I asked the manager of the Fukushima factory at the time whether I should give direct orders at the factory or if we should open a new factory in an area under the jurisdiction of Chubu Electric Power Company, where there was no planned power outage. The manager advised me that opening a new factory would be better. Therefore, in late March, we started looking for an area to start a new factory in Nagano and Aichi. In April, we found a temporary factory in Toyokawa City, Aichi Prefecture and officially started operation on July 1. At the time, I met with Mr. Omura, the Aichi Prefecture Governor, who told me that we were the first disaster-affected company that branched out into Aichi Prefecture. If it had not been for the earthquake, we would not have come to Aichi.

You launched the new factory very quickly.
President Watanabe: Yes, we started the factory with six processing machines in a very short period of time. At the time, we had no customers in Aichi Prefecture. During the first year, we were merely providing support to the Fukushima factory. However, in July 2012, we started sales activities in Aichi. At present, with 90% of our customers being in automobile-related industries, we have acquired some 100 customer companies, many of which are so-called “tier-2” companies. We accept orders for any product that needs to be cut with wire, including automobile-related products. Our motto is to deliver products in the shortest time at the lowest cost in Japan. Up until the Lehman crisis, we had been offering services for the same price as in China. At present, we offer services at prices lower than in China by 30% to 40%.
The cold winter has arrived. This year, with a series of warm days being followed by a sudden heavy snow, the FANUC Forest appears slightly different from ordinary years. The following photos show how the forest looks this year.

**Japanese Andromeda buds**  
(Photo taken January 30 in the vicinity of the company houses)  
On the morning after a freezing rain, trees were covered in transparent ice. The tiny buds are enduring the cold, waiting for the advent of spring.

**Earthstar**  
(Photo taken December 15 near the Ashikike pond)  
Despite its appearance, the earthstar is a species of mushroom. The outer skin opens in the shape of a star to allow dark brown spores to be released from the hole at the tip of the round sack.

**Thrush**  
(Photo taken February 1 in the vicinity of the Chuo TC)  
Thrushes are migratory birds that come to Japan during the winter. This thrush was looking a little puffed up—whether it was because the FANUC Forest abounds with food or because it is cold on a snow day even for a winter bird.

I tell our employees that we need to be No. 1 in Japan not merely in terms of the overall evaluation of costs, delivery time and product quality, but in terms of every one of these elements. If we can become No. 1 in terms of all these elements, we will be No. 1 by far. Then, none of our customers will feel they have lost something by doing business with us. And to make sure that we actually don’t cause a loss to our customers, we cannot afford to lose to competitors regarding any of these three elements. We would like to apply the best of our abilities to support manufacturing in Japan and to enhance its competitiveness through the process of wire electric discharge machining.

**Without holding back, how do you evaluate the ROBOCUT?**  
**President Watanabe:** It is the best in cost performance. It is superior to other companies’ products especially in terms of running costs. Also, it can be serviced quickly in case of a breakdown. When we began shifting to the new business, the molding industry was facing an economic recession and manufacturers were not interested in increasing development costs. Therefore, many manufacturers released products that were not much different from previous ones when changing models. However, FANUC released models that met our requests for increasing the processing speed.

**How would you like to change this factory in the future?**  
**President Watanabe:** We bought an old factory for our production in this area. The second floor of this factory is still left untouched. We need to use all available resources to expand this factory to install up to 40 machines. Then, this factory will be the largest single wire electric discharge machining factory in Japan.

**Do you have any requests to FANUC?**  
**President Watanabe:** First of all, I would like to thank you for providing us with support in various ways, including delivery periods. We owe a great deal to FANUC’s support for the rapid increase in the number of our wire electric discharge machining systems in this industry and we would like to request your continued support. Secondly, our major products are automotive parts, so we would like you to increase the speed of processing thick materials. We will collaborate with you in gathering data, so let’s do it together. We are looking forward to working with FANUC.

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(Written by Naoki Yukisada, Public Relations Department Vice Manager)
Staying true to the spirit of "Service First," FANUC provides lifetime maintenance to its products as long as they are used by customers through more than 252 service locations in 46 countries throughout the world.