

CYBERWORLD

Feature

Production innovation with Digital Twins

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2020
No. 60

DIGITAL TWIN

Production innovation with Digital Twins

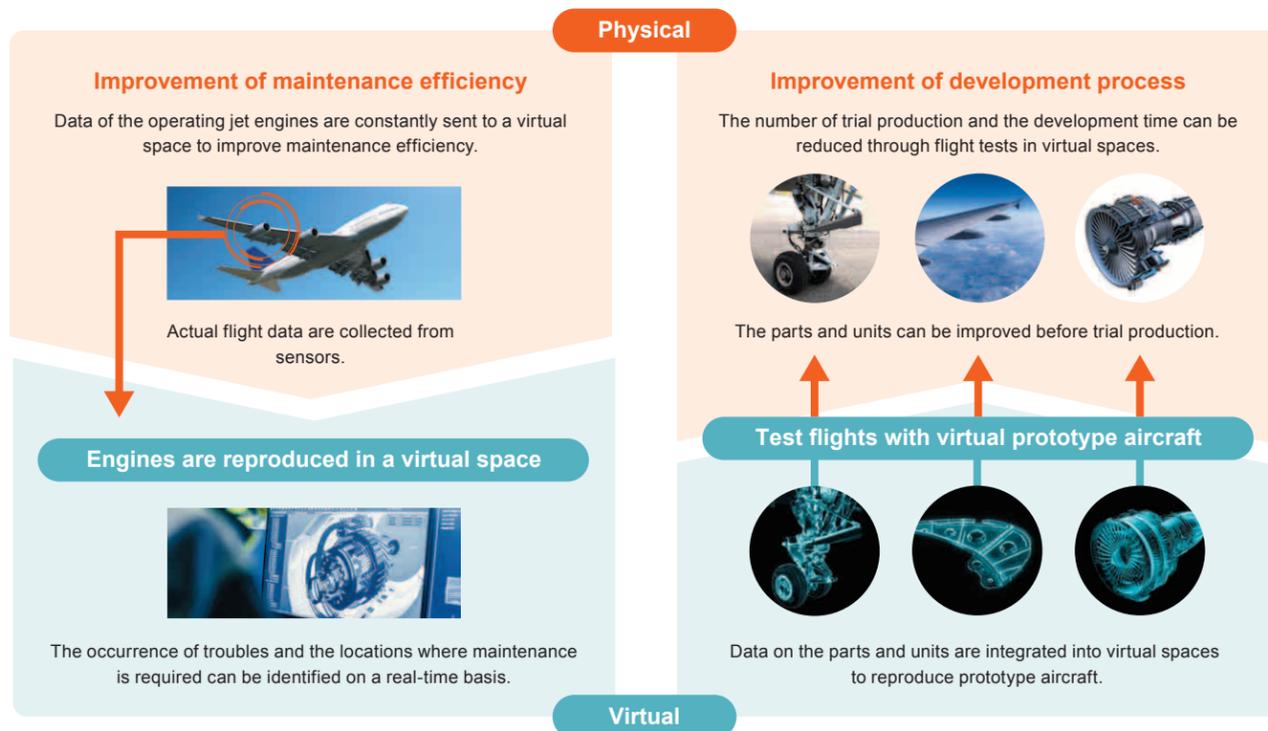
The Internet of things (IoT) connects everything to the Internet. A technology that has recently drawn attention along with the dissemination of the IoT is "Digital Twins". Digital Twins are digital replicas of physical assets, process, or system. They are different from conventional simulations in terms of the reproducibility and synchronizability. Thanks to the progress of the IoT, we can collect information in the real world in more accurate, real-time manner which enables to perform more sophisticated simulations.

In the aerospace industry, for example, digital twins are utilized to improve the safety of jet engines and the efficiency of its maintenance. Various data such as flight data and operation status of engines are collected from the sensors attached in various places of an aircraft on a real-time basis. The status of engines during a flight is replicated in a virtual space and high-precision simulations are performed to implement monitoring of the operation and predictive maintenance to prevent serious troubles.

Digital twins are also used in the process to develop airframes. For example, all parts and units are converted into data to fully reproduce prototype aircraft in virtual spaces. Test flights of the virtual prototype aircrafts can go through a range of simulated environments to identify the points to be improved before trial production. This will contribute to reduce the number of trial production and development lead time.

Today, digital twins are already in practical use and their introduction is being considered in a wide range of industries and sectors including development, manufacturing and services. In particular, the manufacturing industry has big expectations that the effective use of digital twins helps solve problems such as the decline of the labor force population, the shortage of skilled workers and improvement of productivity.

Examples of using digital twins in the aerospace industry



MAZATROL TWINS —Software for Digital Manufacturing—

MAZATROL TWINS

Establishing digital production sites in virtual space

Creation, simulation and analyzation of machining programs



Smooth CAM Ai

Programming and simulation on office PCs

Conjunction with CAD/CAM software



Smooth Project Manager

Synchronizing between machining data, Smooth CAM Ai and other CAD/CAM software

Tool management



Smooth Tool Management

Establish tool database and share with Smooth CAM Ai

Monitoring and analysis of operation



Smooth Monitor AX Smooth Link

Real-time monitoring and analysis of machine operations

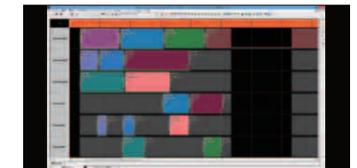
FMS management



Smooth PMC

Output of FMS is estimated and the appropriate tools are simulated

Process planning



Smooth Scheduler

Simulation of the entire plant operation

Production improvement based on digital twins with MAZATROL TWINS

Mazak develops and supplies machine tools and software utilizing cutting-edge technologies such as digital twins and artificial intelligence (AI). MAZATROL SmoothAi is CNC system that features high productivity based on the function to create programs easily with AI technology as well as sophisticated machine control. We offer high-efficiency digital manufacturing that combines latest CNC system along with digital twin-based software series named "MAZATROL TWINS."

MAZATROL TWINS software series has various functions and reproduce virtual factories and machine tools on office PCs. For example, Smooth Tool Management is software to build tool database that supports efficient programming and machining simulation on office PCs. Smooth PMC is software that performs

real-time simulation on office PCs during the operation of automated systems to estimate operational load and output in each machine to improve the operational efficiency of FMS. With Smooth CAM Ai, machining programming and other setup tasks, which are conventionally carried out in production sites, can be conducted on office PCs. High-precision simulations of machining can be performed using virtual models.

Different types of data that have been conventionally managed separately can be integrated into virtual spaces on office PCs in an accurate and real-time manner through MAZATROL TWINS software. As a result, operation analysis and simulations of entire plant can be performed in office to achieve optimal plant operation.

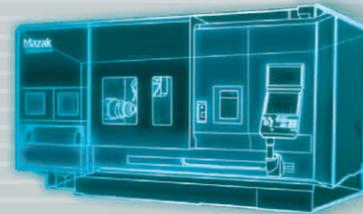
Virtual space

1 Establish a virtual machine on an office PC
(precise replica of an actual machine based on data provided from the machine)



Smooth CAM Ai

CAM software corresponding to the MAZATROL SmoothAi



2 Create a machining program through sophisticated simulations



Solid MAZATROL

Machining programs utilizing AI
- Automatic MAZATROL programming using 3D CAD data
- Estimation of optimal machining process determined by AI



Virtual machining

Precisely reproduce actual machine movements using 3D models
- Interference checking
- Estimation of machining time



Cutting Adviser

Optimize machining conditions and reduce machining time if there is room to further improve machining load
- Estimation of spindle load during machining
- Estimation of the material removal rate

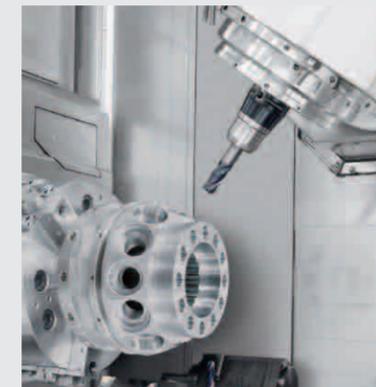


Physical space

4 The first workpiece with actual machine
(fine-tune of machining conditions)



Mazak machine equipped with MAZATROL SmoothAi



5 Provide feedback on changes

- Actual value of machining load
- Actual measurement value of tool length
- Changes in the machining conditions
- Parameters



3 Transfer data to the actual machine

- Machining programs
- Verified simulation data

Advantages of digital twins

Improve productivity with prior verification through digital setup and feedback



Digital setup using virtual machine tools

Smooth CAM Ai, one of the MAZATROL TWINS software series, is CAM software to produce virtual machine tools on office PCs. Virtual machine tools on this software synchronize to actual machines based on data provided from the machines through a network. Operators can create machining programs and perform setups from offices as if they are standing in front of the actual machines. Mazak calls this "digital setup."

Smooth CAM Ai receives tool data, parameters and other data registered in actual machines equipped with the MAZATROL SmoothAi. The effective use of these data enables to create machining programs on office PCs. The software also

automatically determines the machining process of conversational programs based on 3D CAD data of workpieces to considerably reduce the programming time. In addition, machining programs created with the software are optimized through sophisticated simulations using digital twins. For example, the machining time can be shortened efficiently by analyzing the material removal rate of each tools to be used and preferentially review the machining process using the tools with a higher material removal rate. Moreover, mechanical interference can be spotted in advance to prevent interference in actual machines by reproducing movements in actual machining in 3D models on office PCs.

Digital setup is performed accurately on office PCs to identify problems in advance to take responsive measures, which can significantly reduce the setup work in production sites as well as the number of trial production before the first machining.

After the launch of mass production machining, real-time data of actual machines are sent to Smooth CAM Ai on office PCs for further improvement of machining. For example, actual machining data related to machining load and tool length are sent to Smooth CAM Ai. Smooth CAM Ai then automatically optimize machining parameters, to calculate the most suitable cutting depth and feedrate, to shorten machining time.

By sharing these information between office and production site, Smooth CAM Ai continuously performs an analysis of the data to optimize machining process for further production improvement.

MAZATROL TWINS provides unsurpassed productivity by even faster setups, machining times and superior surface finishes. Mazak will contribute to innovate your production by efficiently utilizing Mazak digital manufacturing solution.



Sankyo Shizuoka Seisakusho Co.

Chairman and CEO : Hiroumi Ogawa
 Address : 2290 Honjo, Kikugawa, Shizuoka, Japan
 Number of employees : 202

www.sankyo-seisakusho.co.jp



Customer Report 01
Aiming to be the top supplier of cam products in the world

Japan Sankyo Shizuoka Seisakusho Co.

Rotate, stop and position. Stable and high-precision control of such motions of industrial machines requires cams to work effectively. Sankyo Shizuoka Seisakusho, which is located in Kikugawa, Shizuoka, is one of the world's largest plants dedicated for cam productions. The plant manufactures various positioning devices using the cam mechanism and the products created in the plant which underpins the movement of machine tools and various other industrial machines such as welding machines for automobile and semiconductor manufacturing equipments.



02



03



04

- 01. FMS line built with the INTEGREX i-V and the HCN to facilitate automation
- 02. The INTEGREX e-V used for machining large parts
- 03. Processes are integrated into multi-tasking machines to improve accuracy and productivity of parts
- 04. Mr. Kazuki Yagi, General Manager (third from left, back row) and employees

Sankyo Seisakusho, the parent company of Sankyo Shizuoka Seisakusho, was founded in 1938 by Mr. Ryohei Ogawa, the father of Mr. Hiroumi Ogawa, Chairman and CEO, in Kita Ward, Tokyo. The business started with the manufacturing of aircraft parts and caterpillar parts. While developing positioning devices for in-house equipment, the company looked at the depth and potential of the cam technology and gradually shifted its business to the design and manufacturing of positioning devices. Sankyo Seisakusho commercialized roller gear cam fixed positioning devices for the first time in Japan in 1973. Foresight and passion of Mr. Ryohei Ogawa have lead the company to achieve the reputation, "most of the roller gear cam free positioning devices used in machine tools manufactured in Japan are produced by Sankyo." Mr. Kazuki Yagi, General Manager of Shizuoka Manufacturing Division, explained.



Mr. Kazuki Yagi, General Manager (left), and Mr. Kengo Suzuki, General Manager, explaining the strength of the company

Sankyo Shizuoka Seisakusho started its operation as the Shizuoka Plant of Sankyo Seisakusho in 1981 and was spun off in 2017. The company manufactures RollerDrive, a free positioning device, and various other products using roller gear cams as the core technology. Under the customer-first policy, the company also produces custom-made items along with general-purpose products. "While the product-oriented approach has been the

strength of our company, we also aim to continue to meet the expectations of customers through market-oriented manufacturing," according to Mr. Kengo Suzuki, General Manager of Product Development Division.

Aggressive investment to seek higher production efficiency

The first Mazak machine for Sankyo Shizuoka Seisakusho was INTEGREX 30Y, which was introduced in 1996. "MAZATROL program was easy to understand and looked very attractive," as stated by Mr. Yagi. Since then, 42 Mazak machines have been installed in total. In the last two years as well, eight machines and two automation systems were installed in the company's state-of-the-art plant named "Sankyo Dream Factory" to further enhance high-efficiency, high-mix low-volume production system. Mr. Yagi stressed the effect of the investment, saying "While the full-scale operation has not started, the operating time has already improved by 40% in comparison with conventional automation systems. In the near future, we will be able to machine total of 250 parts with eight machines running 48,000 hours/year operated with five staff."



FMS line of the INTEGREX i series installed in Sankyo Dream Factory

To improve productivity, Sankyo Shizuoka Seisakusho also invests aggressively in software in addition to equipment and devices. Smooth Monitor AX, an operation monitoring and analysis software is one of the software

they have implemented and was installed together with automation systems. "We plan to start with the analysis of the alarm stop time and try to further improve productivity," Mr. Yagi explains their objective. The company is now considering to implement new CAD/CAM software as well. The aim is to shorten the machine setup time by completing and simulating machining programs in the office.



Smooth Monitor AX realizes visualization of operation status

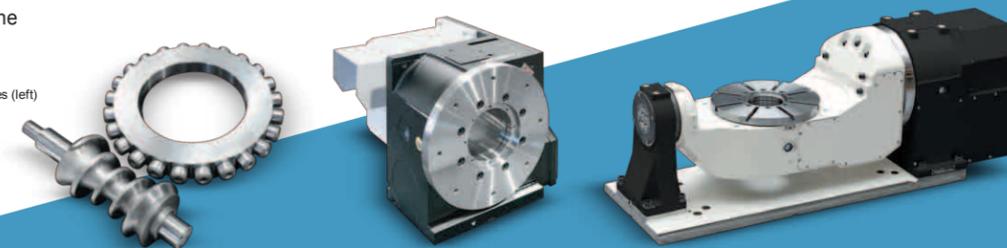
Providing extensive support in Japan and overseas

Sankyo Shizuoka Seisakusho is one of the largest plants in the Sankyo Seisakusho Group providing extensive support to their group factories in both Japan and overseas. Not only they provide core parts for their product, they also hold a role to evaluate their latest assessment, development of human resources, and many more.

"We want to make sure our staff know how to fully operate their machines and to have this knowledge properly shared among all staff," states Mr. Yagi. Hence, Sankyo Shizuoka Seisakusho is committed to take initiatives to develop their human resources from both domestic and overseas factories. As part of their long-term strategy, trainees accepted in the company will be trained to become certified technicians.

"In particular, the plant in Vietnam will further grow in the future. We want to develop the personnel who will play the key roles in our site," Mr. Yagi said enthusiastically. The dream of the founder to become the top supplier of cam products in the world is being steadily turning into reality.

▶ Roller gear cam machined with Mazak machines (left) and positioning devices using it





01

COMPANY PROFILE //



STK Technology Co., Ltd.

President : Masato Tasaki
 Address : 2468-10 Misa, Oita-city, Oita, Japan
 Number of employees : 500

www.stk-net.co.jp



Japan STK Technology Co., Ltd.

Customer Report **02**

Establishing a high-efficiency production system in preparation for 5G and EVs

Japan STK Technology Co., Ltd.

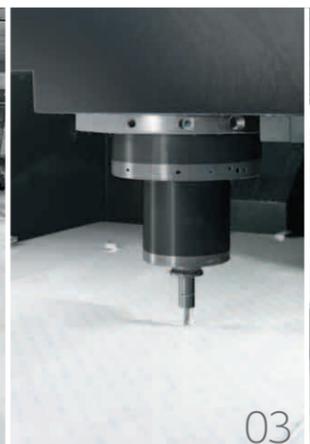
While semiconductors are used in various industries, those used in electric vehicles (EVs) and other automobiles requires especially high quality and reliability as these parts directly affects safety of vehicles. One of the devices used in their final quality tests is burn-in equipment. STK Technology Co., Ltd., which is located in Oita City, Oita, has a strong presence as one of a leading manufacturers who develop and produce burn-in equipment in Japan. The company aims to strengthen its capacity to meet the demand that is expected to increase with the 5G communications network as well as the shift of automobiles to EVs. Its strategy is supported by various Mazak machines.



Oita, Japan



02



03



04

- 01. Two pallet changers are equipped for five vertical machining centers to shorten production lead time
- 02. Many Mazak machines installed in the new plant
- 03. Long flat plates can also be machined with high precision using FJV, vertical machining center
- 04. Mr. Hiroaki Nojiri, Senior Managing Director (fifth from left, back row), Mr. Masaki Takahashi, General Manager (fourth from left, back row) and employees

STK Technology, which is a group company of Tsurusaki Sealand Transportation Co., Ltd., was founded as Shintsurukai Kosan Co., Ltd. in 1975 and engaged in electric measurement. Located in Oita Prefecture, which is known for semiconductor-related business, the company later entered the semiconductor industry. The corporate name was changed to STK Technology in 2000 with STK standing for "Shin Tsuru Kai." STK Technology has established a unique position in the development and manufacturing of burn-in equipment, which applies temperature and voltage stresses to semiconductor chips to identify defective pieces before shipment. Automobile semiconductors are required to have especially high quality because they are used in a harsh environment. The burn-in equipment produced by the company can be considered to be the last "bastion" to guarantee the quality of automobile semiconductors. "The reliability of semiconductors has to be high because they may be used in products involving human lives. That is why the mission to detect defects before shipment is crucial." Mr. Hiroaki Nojiri, Senior Managing Director, emphasized the importance of the equipment.



Mr. Hiroaki Nojiri, Senior Managing Director (right), and Mr. Masaki Takahashi, General Manager, talking about the importance of burn-in equipment

Using the unique know-how cultivated through the development of burn-in equipment, STK Technology also operates the test house business, in which it contracts to provide a full range of services from programming of semiconductor tests to evaluation and analysis. "Our strength is that we can give comprehensive support to the test process based on the technological capacity and skillful know-how

characteristic of semiconductor equipment manufacturers." Taking advantage of the machining techniques accumulated through the production of burn-in equipment, the company has also expanded into the mechanical and sheet-metal machining business. In addition to machining of parts of in-house products, the company takes on machining of parts for major manufacturers of semiconductor manufacturing equipment as well. A new precision machining plant was built in 2019 to further enhance the mechanical and sheet-metal machining business.

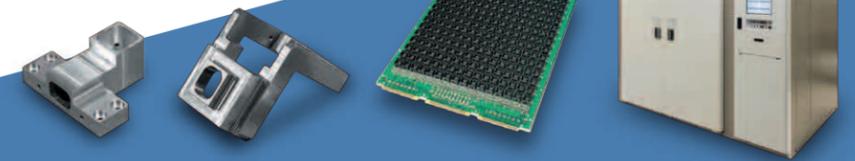
Mazak machines are user-friendly
 STK Technology produces a wide range of parts for semiconductor manufacturing equipment in small lots. To perform such high-mix, low-volume production with high precision and high efficiency, various Mazak machines have been installed. In the newly built precision machining plant, 16 Mazak machines are operated in total. They include FJV and VTC vertical machining centers, HCN horizontal machining center and the 3D FABRI GEAR laser processing machine. "We were surprised at the user-friendliness of the MAZATROL and its programming speed. It is helpful because we can operate the machines as if they were part of our bodies." Mr. Masaki Takahashi, General Manager of Precision Machining Department, evaluates Mazak machines.



Machining of small parts with the HCN

The 3D FABRI GEAR, a laser processing machine, can complete various processes for the manufacturing of burn-in equipment

► Parts of semiconductor manufacturing equipment machined with high precision (left), burn-in board and burn-in equipment



The 3D FABRI GEAR halved the production lead time

including cutting, tapped hole preparation and tapping alone which shortens the time needed for welding in the subsequent process. The introduction of 3D FABRI GEAR has reduced the production lead time by 50%. STK Technology has also introduced the Smooth CAM RS, which is a software that enables centralized control of machining programs and reduces the setup time.

High value-added manufacturing system with automatic operation

Characteristic of the semiconductor market is that demand fluctuates. Therefore, STK Technology is committed to establish a robust business structure that will not be influenced by fluctuations. This spring, the company newly installed Mazak's HCN-5000 and PALLETECH HIGH RISE SYSTEM to set up an automatic operating system integrated into existing machine. Mr. Takahashi said, "After the start of full-scale operation, we can perform unmanned operation late at night and on weekends, which enables employees to spend more time on higher value-added tasks. This is also part of our efforts to cope with a labor shortage and promote work style reforms."

In preparation for future increases in demand for semiconductors, STK Technology also plans to construct a new plant on its property. The dissemination of 5G and shift to EVs will further boost the demand for burn-in equipment in the future. The equipment will not only work for semiconductors but also help people to have a sense of security for the new society.

MAZAK PEOPLE

European Parts Center Order Administration Coordinator

 **Mr. Patrick Fripon**

Leveraging extensive experience to support the whole of Europe

Yamazaki Mazak operates many bases in Japan and other countries for various functions such as production, sales and before and after-sales service and support. MAZAK PEOPLE introduces employees who are active at the forefront of the Group companies. This issue features Mr. Patrick Fripon, who is a coordinator in the European Parts Center (EPC). Working actively as a specialist in spare parts with extensive experience, Mr. Fripon aims to increase the percentage of parts delivered promptly.

PROFILE » Mr. Patrick Fripon

Mr. Fripon joined the company in 1981. Having been engaged in jobs related to spare parts and after-sales services since then, he also worked for the establishment of parts centers in Europe. He is now working actively as a coordinator in EPC, which supplies spare parts across Europe.

—What is the role of EPC?

EPC was established in the site of Yamazaki Mazak Europe N.V. (in Belgium) as the headquarters for the supply of spare parts across Europe in 1990. Having been expanded in 2015, EPC now supports after-sales services for customers, agencies and distributors throughout Europe 365 days a year.

The current target of EPC is to keep the rate of prompt delivery, which means the shipment of spare parts on the same day when a customer places an order for them, at 98% or higher. While it is very difficult to always maintain that rate of prompt delivery, we have continuously achieved that target since the expansion of EPC. In order to maximize the productivity of customers, it is necessary to minimize the downtime of Mazak machines.

In the meantime, much emphasis is placed on the supply chain (the series of activities ranging from procurement of raw materials and parts to manufacturing, production management, sales, delivery and consumption) in Europe. Failure of machine tools, which underpin the fundamentals of manufacturing, can also affect the supply chain. Therefore, the existence of EPC, which enables customers to obtain necessary parts quickly when they are needed, is essential in the European market and the rate of prompt delivery of 98% is a target that EPC should continue to achieve.

—What is your current job?

I manage the European Order Administration Team, which handles requests from customers all over Europe. We check the backlog of orders and discuss progress at the daily meetings. Also, we pay attention to inquiries about spare parts received by EPC and our support bases across Europe every day and give support to our colleagues throughout Europe in addition to EPC.

—When EPC was expanded in 2015, how did it change?

The expansion in 2015 increased the total floor area significantly to make it possible to store 35,000 kinds of spare parts, more than double the previous number. Accordingly, we became able to ship spare parts on the same day when customers place orders for them. In addition, many customers from all around Europe have visited EPC for inspection since its expansion. Equipped with cutting-edge facilities, EPC also seems to play a part in marketing activities.

—What is the strength of EPC in the European market?

As a base to supply spare parts throughout Europe, EPC aims to reduce the logistics cost and offer a higher level of services that satisfy customers.

EPC has established a distribution environment to handle and ship spare parts ordered before 8:00 p.m. on the same day. Our partner carriers have a logistics network across Europe and can, therefore, meet requests from all over Europe immediately.

The continuous achievement of the target to maintain the rate of prompt delivery of 98% is the greatest strength of EPC.

—What is your future goal?

I have been engaged in international jobs related to spare parts and after-sales support. Using that experience, I provide training on how to use databases to respond to requests from customers quickly and accurately not only in EPC but also across Europe.

My future goals include the continuous provision of such support to cultivate young employees, as well as the support of the establishment of new management systems that will be introduced

all over Europe. I aim to share information with colleagues and also support them using my experience.

"Using the knowledge and experience I have obtained in Mazak, I would like to train young employees across Europe," said Mr. Fripon. With the attitude to pass down all of his extensive knowledge and experience on spare parts to young employees, he will become a reliable supporter for young employees all over Europe, as well as a role model for them.

How he spends his days off

I like cooking and spending time with my family and friends. They are excellent pastimes for me.

I go walking on weekends because I just love it. I enjoy walks to popular places in the neighborhood such as a castle and a vineyard.



News & Topics Introduction of new products

Simultaneous 5-axis Vertical Machining Center



The VARIAXIS C-600, simultaneous 5-axis vertical machining center is designed to be easily integrated with automation systems thanks to the flat surface of the front of the machine and the large operation area. The front door and right side door can be automatically opened/closed for workpiece loading/unloading by a robot.

This machine features a tilting rotary table rigidly supported on both ends to ensure high-speed, high-accuracy machining. A wide variety of spindle specifications, tool magazine capacities and coolant systems is available to meet a wide range of machining requirements.



Wide variety of automation equipment available, such as 2-pallet changer, multi-pallet stockers and robot interface

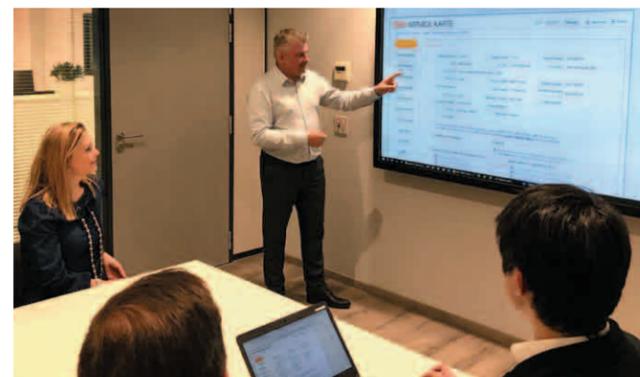
Equipped with the MAZATROL SmoothAi, the latest CNC

Ai Thermal Shield

Ai thermal shield automatically determine the amount of compensation to be applied to changes in the temperature to ensure even higher machining accuracy.

Smooth RCC

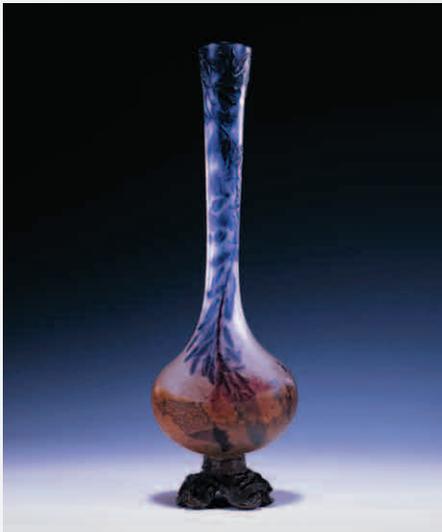
Teaching of robot hands can be completed by inputting minimal data in conversational way, such as the shape and grasping width of the material, to help shorten the time for the automation system to operate.



Team meetings are held twice a day for the purpose to share information

This issue does not include the Customer Report (outside Japan).

The Yamazaki Mazak Museum of Art was opened in April 2010 in Aoi Higashi-ku, the heart of Nagoya in order to contribute to the creation of a rich regional community through art appreciation and, consequently, to the beauty and culture of Japan and the world. The museum possesses and exhibits paintings showing the course of 300 years of French art spanning from the 18th to the 20th centuries collected by museum founder and first museum director Teruyuki Yamazaki (1928 - 2011), as well as Art Nouveau glasswork, furniture, and more. We look forward to seeing you at the museum.



Collection Showcase 1
THE YAMAZAKI MAZAK MUSEUM OF ART

GALLÉ, Émile
“Engraved vase
with wisteria design”

The motif of this vase is wisteria. There are fully open flowers at the top, partially opened buds a little lower, and closed buds at the bottom, delicately showing the various stages of opening of the flowers. Sinuous curved lines around the mouth of the vase form heavy, curved leaves. The delicately modeled form of the hanging flower cluster is blown by a breeze in a gentle S curve. The bronze base has a leaf design with small snails on the leaves. It is a type of metal base often used with Gallé vases and was not made specifically for this vase. There are variants using a similar wisteria motif. The ones in the Düsseldorf Museum and the Museum Bellerive, Zurich have handles on both sides.

GALLÉ, Émile [1846-1904]
“Engraved vase with wisteria design”
1898-1900

Collection Showcase 2
THE YAMAZAKI MAZAK MUSEUM OF ART

FRAGONARD, Jean Honoré
“Favorable Inspiration”

Sappho was a female poet of ancient Greece who lived from the end of the 6th to the early 7th century B.C.E. Plato sung her praises, calling her the tenth muse, and visual depictions usually show her holding a lyre. Most of her poems are love poems, but with the exception of Hymn to Aphrodite, her work exists only in fragments. Sappho later became notorious for her love of women as well as for her work, and the word Lesbian comes from the Isle of Lesbos where she lived. Because of this, the Christian church regarded her as sinful, and she was portrayed seductively in painting, dressed in loose clothing with exposed breasts and listening to Cupid’s whispers while writing poetry.

The theme of a creative genius receiving inspiration was used more and more frequently in art from the 1760’s onward. Great importance was given to witty conversation in the social life of the 18th century. Writers, philosophers, poets, and musicians were idolized and their talent was thought to be heaven-sent.

This work is conceived in a romantic context, a supernatural moment in the work of a genius. It has features typical of Fragonard that provide sensual pleasure to the viewer, the beautiful illumination of the poet’s breasts, the sensual white and rose of the skin, and the delicate beauty of the infant who whispers in her ear.



FRAGONARD, Jean Honoré [1732-1806]
“Favorable Inspiration”
1776-77
Oil on canvas