The All-in-One Application Advantage

A Look at Complex, High-Performance Five-Axis Machining Solutions

Matthew Jaster, Senior Editor

With new manufacturing challenges in every industry from aerospace to automotive, construction to mining and energy, more gear manufacturers are entertaining the idea of adding complex, five-axis machines into their shop floor equipment.

Diverse part production, multiple setups, and productivity gains are just a few of the advantages to five-axis machining. Many shop visits in recent years start or end at a five-axis machine with the operator bragging about how the unit is either the workhorse or the best machine tool found in the factory. Here's some recent highlights from five-axis machine tools:

Methods Machine Tools

INTRODUCES FIVE-AXIS BRIDGE-TYPE MACHINING CENTER

Methods Machine Tools, Inc. has introduced the all-new Methods MB 450U Simultaneous five-axis Bridge-Type Machining Center, loaded with features and capabilities for efficiently manufacturing complex parts with a high degree of quality, reliability and accuracy.

Due to the FANUC 31i-MB5 control, this machine is able to perform full five-axis precision machining of challenging parts, significantly reducing the need for multiple setups. Thanks to the control that is available exclusively to Methods, due to its partnership with FANUC, Methods Machining Centers are the only machines from Taiwan that can offer five-axis simultaneous.

"In addition to having a unique, powerful FANUC control, the MB 450U machining center is packaged with comprehensive, high end functionality for exceptional performance," said Nicholas St Cyr, machining centers product manager. "We are pleased to offer customers a five-axis machining solution that is fully loaded with robust features and provides high value for the cost. Also, we offer our customers tremendous depth of support through Methods industry leading application engineers, technical service and parts support."

The FANUC 31i-MB5 Simultaneous five-axis control has a 15" color display and includes a range of powerful standard features including a 2 GB data server, Manual Guide I, AICC II 600 Block Look Ahead, 1 MB of NC memory and 0.4 ms Block Processing Time. The FANUC control offers collision detection with a 3D interference check and a Fast Package III with tool center point control.

Methods MB 450U features a 15,000 rpm Big Plus, 40-Taper Spindle with air-oil lubrication and a spindle chiller for longevity. A 15 hp hollow shaft spindle motor with 1,000 psi (70 bar) coolant-thru spindle prep and couple is also standard. The new MB 450U five-axis Bridge-Type Machining Center includes a large capacity, dual swing arm-type 48-tool automatic tool changer. Travel is 15.7" (400 mm) on the X-axis and 13.8" (350 mm) on the Y and Z-axes. The B-axis has -50°~+110° tilting capability and the rotary C-axis has a 360° rotation angle.

Offering high machining stability, the MB 450U has a robust bridge-type construction with thermal compensation including 1.771" (45 mm) linear roller guide ways in the X/Y-axes and 1.377" (35 mm) in the Z-Axis and weighs 13,250 lbs. (6,000 kg). Heidenhain linear scales in the X/Y/Z axes and Heidenhain rotary scales in the B & C axes offer high precision part production. Kinematic calibration features a spindle probe with a table center point calibration ball and kinematic software. A laser tool measurement system detects tool wear, damage and breakage, reducing non-productive time and enabling automated operation.

For more information:
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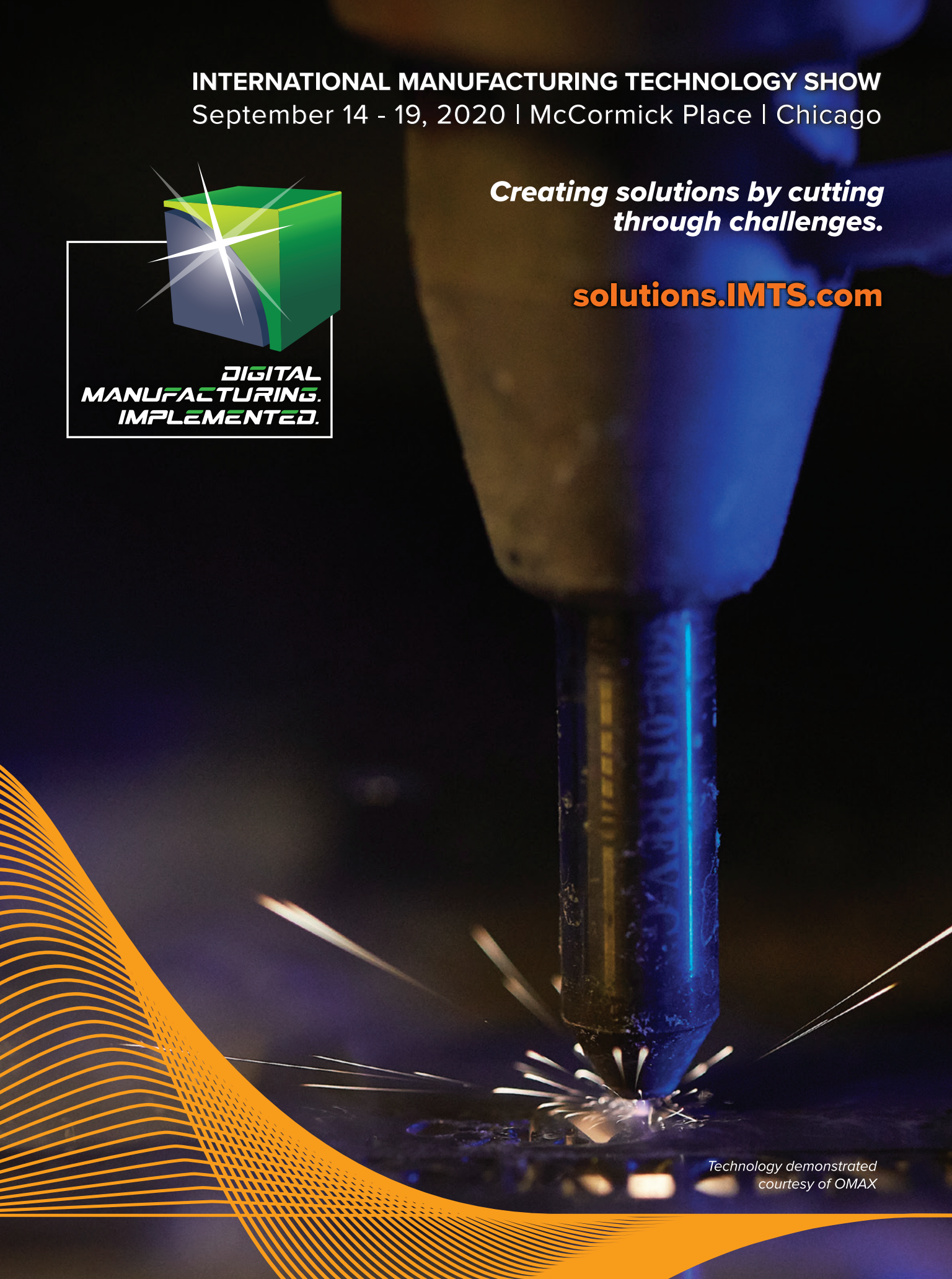
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Doosan

OFFERS DIVERSE LINEUP OF FIVE-AXIS TECHNOLOGY

Producing complex parts for industries such as aerospace, automotive, medical, firearms, and others allows Doosan the opportunity to offer manufacturers a single-setup machine tool solution instead of cobbling together a machine line to slightly boost productivity. Here are some of the recent highlights to Doosan's five-axis machine tool lineup:

DVF 5000

The DVF Series is fully loaded to handle diverse 5-sided or simultaneous five-axis applications to meet a variety of customer needs.

The machine table is now an integrated cantilever style full five-axis table allowing you to tackle your parts from angles you couldn't on the DNM. We are presently offering a machine with a table diameter of 19.7" (DVF 5000); other table diameters slated for a Q3 launch will include 26" (DVF 6500) and 31.5" (DVF 8000). With this range of table diameters, you will be able to choose the size you need for your type of work. The DVF 5000 features a built-in 25/29.5hp (continual/short-term) 18,000 r/min spindle, allowing for high speed metal removal. It also comes standard with a 60-tool magazine, with options of up to 120 tools, to tackle your complex parts without having to re-tool your machine each time.

Another advantage of the DVF 5000 is the optional Automatic Work Changer which gives you lights-out capability. It can be ordered in numerous pallet configurations: 4/6/8/10/16, etc.

Here's what Paul Anderson, applications engineer at Doosan had to say about the DVF 5000:

"Over the last 10 years, we've made plenty of machine tool advancements. Quantity, quality, getting our name out there. But the DVF is easily our biggest game changer right now. Where we used to concentrate on lathes, VMCs, our segue into five-axis has been really positive."

Anderson has worked in machining for 41 years, 38 with CNCs. He's programmed and run more projects than he can count.

"Our first five-axis machines were very good, but with the DVF 5000, we now have a more customer style machine that can go head-to-head with the other name brand manufacturers," Anderson added.

VCF 850LSR

The VCF 850LSR is a large, multi-purpose, vertical machining center that is equipped with a 18,000 r/min CAT40 B-axis swiveling spindle head that has X-axis travel of 118". With this machine, you have two choices in the type of C-axis available: a mounted ø19.7" rotary table, or a built-in ø31.5" rotary table. With a 138"-long table, plus a standard center dividing partition (which can be easily removed for extra-long work pieces), you can create multiple work zones and keep the spindle removing metal in one zone, while the other is being loaded. For example, you can have an area equipped with the C-axis table for five-axis work, and another area of the table dedicated to 3- or 4-axis work—maximizing the uptime potential. If flexibility is what you need in a five-axis machine, this would be a great choice.

DHF 8000

It's not only verticals and 40 tapers that offer Doosan five-axis technology. Built from the NHP high performance horizontal machining center series is the DHF 8000, a 50-taper nodding spindle five-axis machine. In addition to the full B-axis (360,000 positions) in the 800 mm pallet, the A-axis in the spindle has a tilting range of +60 to –100 degrees, allowing five-axis accessibility. Dual ballscrews in the Y- and Z-axis in an already robust base give it even more rigidity, with a geared 6,000 r/min spindle, users can tackle hard metal aerospace parts. Linear and rotary scales on all axes are standard.

Mazak

ENHANCES FIVE-AXIS CAPABILITIES

From the start of its multitasking machine development process, Mazak strived for completing parts in one setup: A solid raw piece of material enters the machine, and a completed component exits. But to reach DONE IN ONE—part production, many technological advancements had to occur, such as the development of integral motors, controllers/computers with increased processing power and CAD/CAM software.

Higher power controllers, like Mazak's MAZATROL Smooth CNCs, allow manufacturers to maintain data points across milling and turning operations within the same workpiece setup on a multitasking machine. This ensures repeatability and eliminates the risk of human error when moving workpieces from one single-process machine to the next. Further CNC advancements ensured that machines could control a greater number of machining axes and simplify part-programming

requirements.

Unfortunately, traditional belt drives tended to hinder the performance and positioning accuracy of additional spindles on multitasking machines — until the development of integral motor technology. Electric motors that fully encase the machine spindle, integral motors initially delivered speeds up to 5,000 rpm and positioning accuracies within 1 degree. In addition to improving the spindle's ability to stop and position accurately, integral spindle motors introduced the ability to perform complex contours with C-axis turning spindles. For milling spindles, the technology introduced B-axis control to the spindle along with higher rpm and horsepower.

Following the introduction of integral spindle motors, Mazak experimented with the use of worm wheels for further performance improvements, but the design had backlash issues. Instead, Mazak developed a highly capable roller cam design and is currently exploring the use of direct drive technology for milling spindle headstocks on Mazak Multi-Tasking machines. For its vertical Multi-Tasking machine platform, roller cam technology paved the way for Mazak's tilt/rotary tables and full, simultaneous five-axis machining.

But it was the introduction of lower turrets and second spindles that allowed for DONE IN ONE and simultaneous part processing, meaning the machine's upper turret is working on a part in the machine's main spindle while the lower turret works on another part in the second spindle. This configuration resulted in significantly shorter part cycle times and higher machining accuracy along with increased capacity, flexibility and productivity — all with one machine. Here are some five-axis highlights for gear machining:

The INTEGREX i-200ST AG HYBRID machine is equipped with the AUTO GEAR (AG) package, the machine efficiently processes mid-size complex components with the added versatility of twin spindles, milling spindle (S) and a lower turret (T) as well as a full range of SMOOTH TECHNOLOGY solutions specifically aimed at the DONE IN ONE production of gears.

Mazak's AG package gives manufacturers the ability to perform complete

part processing for a wide variety of gear types. The machine can produce datum features, chamfers, edges and other part features in a single set up, reducing the need for redundant workholding and work-in-progress (WIP) inventory.

The SMOOTH Gear Cutting software package includes SMOOTH Gear Skiving, SMOOTH Gear Hobbing and SMOOTH Gear Milling for the production of both external and internal spur, helical and spline-type gears. This assures complete geometric freedom without added complexity — operators can use Mazak's powerful HMI solution to easily create programs on the control. The AG package pairs well with the highly productive INTEGREX i-200ST platform, which features two turning spindles that provide equally high levels of performance thanks to 5,000-rpm speeds and C-axis turning control. Both spindles have a bore capacity measuring 3" (76 mm) in diameter.

With even faster, higher torque spindles, the INTEGREX i-630V/6 machine processes large, highly complex parts in the shortest cycle times possible. When paired with the new TOOLTECH tool system, the machine provides efficient tool storage as well as easy loading and unloading of large size, heavy tools.

A spindle cartridge design gives the INTEGREX i-630V/6 higher horsepower and increased speed as well as ease of maintenance. The rigid CAT 50, 10,000 rpm milling spindle tilts in the B-axis –30/+120 degrees for complex contour machining.

The machine's turning spindle/C-axis features a direct-drive motor and a new bearing design along with glass scales. All of which further boosts rigidity, stiffness and accuracy. The robust turning spindle with C-axis control delivers 50 hp and 550 rpm.

For C-axis contouring versatility at either turning spindle, the INTEGREX i-200ST AG uses a vertically mounted milling spindle that provides 30 hp (22 kW), 12,000 rpm and a rotating B-axis range of +120° and -120° for 240 degrees of motion.

Able to accommodate workpieces up to 41.3" (1,049 mm) in diameter and 39.3" (998 mm) high, the machine comes with a two-pallet changer that accepts square 24.8" (630 mm) × 24.8" (630 mm) pallets or round 31.5" (800 mm)-diameter pallets. The pallet changer moves pallets in and onto the machine's table within 11 seconds.

DMG

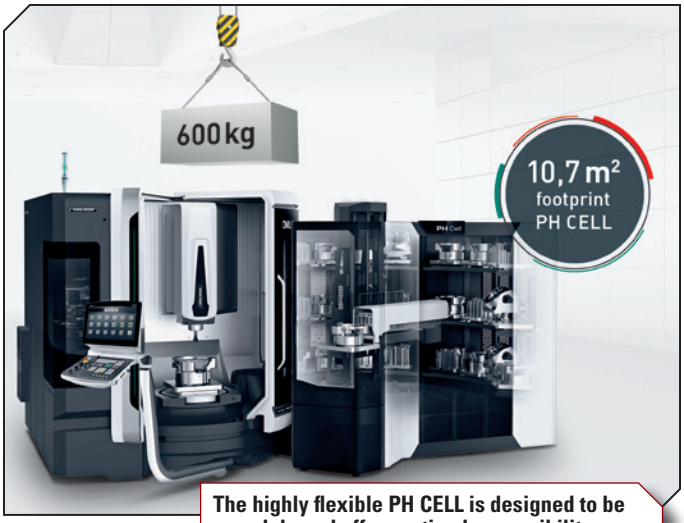
MORI OFFERS INNOVATIVE AUTOMATION PLATFORM FOR FIVE-AXIS MACHINING

The extensive DMG MORI automation portfolio offers innovative and versatile solutions for an autonomous and cost-efficient production for both milling and turning applications. The latest highlight is the new PH CELL for five-axis machining centers and vertical machines. Modular in design the pallet handling system has space for 40 differently sized pallets with dimensions up to maximum 500 × 500 mm.

With a footprint of 10.7 m², the PH CELL is a space-saving automation solution, which enables very autonomous manufacturing even in tight production areas. The pallet system is based on a modular design and offers a high degree of flexibility. The basic version with one shelving module can process up to twelve 500 × 500 mm pallets, sixteen 400 × 400 mm pallets or up to twenty 320 × 320 mm pallets — distributed over three or four shelves. The system can also be expanded with a second shelving module providing up to 40 pallet storage spaces. The second shelving module can also be subsequently integrated. The height of the shelves can be easily adjusted. Every shelf can hold up 600 kg. The transfer weight is maximal 300 kg. In addition to the normal setup station, the modular design also includes a version that can be rotated in 90° steps for improved ergonomics during set-up parallel to production.

The concept behind the flexible PH CELL is that numerous machining centers can be connected, and thus optimally supports DMG MORI's automation strategy. Initially available on the DMU 65 monoBLOCK, it will successively be available on the DMU 50 3rd Generation and the DMU eVo series from May 2020. This will be followed from July with the duoBLOCK models, the CMX U universal machines and the DMC V and CMX V vertical machining center models. It is possible to connect the PH CELL to the machines retrospectively. The prerequisite for this is that an automation interface is available on the machine.

The Robo2Go Vision is an innovative solution that offers a flexible automation layout with free access to the machine and an intelligent safety concept for human-machine collaboration. The Robo2Go Vision, a further development of the flexible robot automation, enables direct loading of Euro pallets and thanks to the new 3D-camera achieves robust recognition without the need of any specific workpiece deposits. With the aid of the dialog-guided control via CELOS and the 3D-camera the teach-in of the Robo2Go Vision takes less than ten minutes. DMG MORI will also be presenting the Robo2Go 2nd Generation on an NZX 2000 with MAPPS control for the first time.



The highly flexible PH CELL is designed to be module and offers optimal accessibility.

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