IMTS Report: Advancing Factory Automation

Competitiveness starts on the factory floor. As demonstrated at this year's IMTS show, innovations and new directions in machine tools and equipment offer new and compelling competitive reasons to invest in manufacturing technology.

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By John Teresko

Increasingly American manufacturers are updating production equipment to sharpen competitiveness," says Paul Warndorf, vice president-technology of the Association for Manufacturing Technology (AMT), the presenter of IMTS, the International Manufacturing Technology Show. The biennial IMTS show was held this past September over eight days in Chicago.

Investment in manufacturing technology is up and growing. Figures released at IMTS reveal that overall U.S. manufacturing technology consumption is up 24.4% in 2006, according to a joint statistical study by AMT and the American Machine Tool Distributors' Association (AMTDA). That's up from April when an AMT/AMTDA study revealed a 21.1% increase over the first four months of 2005.

Exhibitors at IMTS reported record sales. For example, Hardinge Inc., an Elmira, N.Y.-based manufacturer of turning, milling, grinding and workholding solutions, was not only able to meet its already high expectations but more than double it, booking nearly 400 machine orders. "Needless to say when comparing the previous IMTS [in 2004] to this year's, the results were outstanding," says Paula Ameigh, Hardinge's North American sales director.

The supporting factors start with the continuing increase in capacity utilization by durable goods manufacturing, according to Mazak Corp., the Florence, Ky.-based operation of Japan's Yamazaki-Mazak, a global machine tool manufacturer. At about 75% two years ago, capacity utilization in the U.S. is now at 81% and presents a growing need for durable goods manufacturers to add capacity to keep up with demand. That translates to a competitive need to add more effective capacity, replace obsolete technologies, gain productivity, increase inventory turnover and shorten lead times to maintain a marketing edge.

Machine tool customers clearly want to maintain the economic performance of the past several years, as cited by the U.S. Bureau of Labor Statistics: "For the period from 1987 through 2004, while manufacturing employment decreased about 20%, its value-added output has increased by 220%." In addition the inventory-to-sales ratio has decreased by 38%, freeing up capital. And in the 12-year period covering 1992-2004, manufacturing productivity has increased by 62% versus 28% for the service industries, Mazak reports.
Considered geographically, the area with the most dramatic increase in machine tool consumption is the U.S. Central region, with totals for the first seven months running 54.7% ahead of the same time period a year ago.

For the Northeast region year-to-date consumption is 27.4% ahead of the comparable period for 2005, with the Midwest region showing a 12.3% gain while the Southern region's total was level with the same period a year ago. The Western region was 36.8% ahead of 2005 at the same time. Adds John J. Healy, AMTDA's president, "Continued strength can be expected as a result of the trends that historically follow the IMTS show."

That strength is fed by the show's infusion of manufacturing technology from more than 1,200 exhibitors, adds AMT's Warndorf.

Show attendance is the ultimate endorsement. For IMTS 2006, the numbers quickly grew beyond AMT's original estimate of 85,000. The tally reached 90,000 three days before the show's closing on Sept. 13. Final count: 91,985, according to AMT spokesman Robert Gardner.

**Seeing Tomorrow's Technology**

Beginning with the 2004 show AMT opened the Emerging Technology Center (ETC), a special display area intended to give IMTS visitors an extended view -- three to five years -- into the future. The idea, says Warndorf, is to provide show visitors with an area where they can experience manufacturing technology that is still at the R&D stage. Expanded this year, the ETC topical areas included predictive modeling and optimization, micro machining, nanomachining, and smart machining.

Several ETC booths -- Northwestern University and the University of Illinois at Urbana/Champaign -- dramatized the potential of microfactories. Their approach: the creation of miniaturized equipment referred to as meso-Machine Tools (mMTs), integrated into desktop microfactories. Picture a 5-axis horizontal-spindle CNC mMT weighing less than 50 pounds and capable of drilling, milling and five-axis contouring.

In another example, the University of Illinois discussed its prototyping of an integrated system of five mMTs flexible enough for a microfactory style job shop. The system: a three-axis mMT (milling and drilling), metrology station (part measurement) and a gantry (part and sensor transfer). A micro-press is in the process of being integrated. In addition to dramatically reduced machine and maintenance cost, the researchers claim reduced floor space requirements as well as reduced energy, labor and operation costs.

The ETC was sponsored by The Ex One Company, an organization with a focus on nontraditional manufacturing process development. Examples include rapid casting and micro machining technologies.

**Emerged Technologies**
At IMTS 2006, production equipment such as machine tools and robots were significantly updated since the 2004 show. "Although they may look like the machines that were here at the last show, they have been reengineered," Warndorf explains. Using software tools like finite element analysis and modal analysis, machine tool makers have made substantial gains in machine characteristics such as stability, productivity and quality.

One result is a relentless emphasis on machine precision, Warndorf notes. The gains have been profound enough to significantly affect Marposs Corp.'s metrology solutions, adds Gary Sicheneder, manager new market development at the Auburn Hills, Mich.-based company.

Warndorf says one significant motivator for the drive for improved product characteristics is the threat of competition from China. "Another is the higher demands for precision from such industry efforts as the Joint Strike Fighter (JSF) program." Tighter tolerances, he points out, improve the flight characteristics, including fuel economy. He sees a continuing and accelerating drive for greater accuracy as manufacturers of every product category seek enhanced service life, performance and reliability. Warndorf says growing improvements in machine stability are enabling consistency in reaching those goals.

In multitasking machine tools, a new Mazak offering dispels the notion that the concept is only appropriate for bigger operations with hefty parts. The company's new Integrex 100-IV ST is a small workhorse that can handle everything from bar-fed turning to full 5-axis machining. According to the company, benefits include single setup, shorter lead times, reduced fixturing and high precision.

Productivity increases with multitasking since more machining operations can be done on a single machine, Warndorf observes. The demo of the Integrex 100-IV ST at Mazak's IMTS booth involved the production of a stainless steel artificial heart component from bar stock in one fixturing.

To support its customers, Mazak continues to emphasize a holistic manufacturing strategy of collaboration and partnering. The growing evidence: the 27 technology centers Mazak has built in the last decade, starting with the first adjacent to its North American headquarters in Florence, Ky. A world technology center was opened in the spring of 2006 in Minokamo, Japan, adjacent to one of the company's factories. The next one will open near Toronto in December.

"Today, advanced product designs and excellent manufacturing facilities are not enough," says Brian Papke, president of Mazak Corp. "It is necessary to get more deeply involved with customers and not merely sell machines, but truly develop solutions for customers from an engineering, applications and service focus."

Drawing from its manufacturing experience, Mazak is working to help its customers integrate more productive processes in their operations so they too can be competitive and profitable.
manufacturing in the U.S., Papke explains. "Our idea is to partner with customers, suppliers and educational institutions to create unique manufacturing solutions."

**Machines -- More Like Us?**

Production equipment with more human-like characteristics were on exhibit at IMTS, with one obvious example being the new, two-armed robot introduced by Motoman, based in West Carrollton, Ohio. Craig S. Jennings, president of Motoman, alludes to the robot's human-like flexibility of motion: "It can perform tasks that previously could only be done by people." In booth demos the 13-axis dual-arm robot (DA20) was shown tending two Haas lathes, and in another it performed "jigless" operations in an assembly sequence.

But even while robots become more visibly anthropomorphic with designers adding a second arm, another fundamental performance edge may come from adding two other human-like characteristics to machine controls. One is the enhanced ability of an existing machine control to evolve to solve future production challenges, and the other is controls with greater cognitive power (see "Machine Tool Controls In The Future").

At IMTS 2004 machine tool vendor Okuma America launched its new vision of control hardware and software under the THiNC acronym -- "The Intelligent Numerical Control." At IMTS 2006, Okuma demonstrated the significance of what it labels as the only true open architecture PC control. Okuma's Bob Tain, director of THiNC Tank, sums it up as "a machine [control] that can adapt to technology that hasn't even been envisioned yet -- true plug and play.

Okuma's list of partners in leveraging the THiNC approach include Kennametal Corp., BlueSwarf Manufacturing Laboratories, Fanuc Robotics America Inc., Marposs Corp. and Renishaw Inc. The strategy: The partners work together with Okuma to deliver productivity solutions that easily integrate with the THiNC control strategy. One example is Kennametal's Tool Boss inventory management software system. Just by improving accountability and tracking, Kennametal says overall tooling spending can be reduced up to 30% and on-hand inventory can be cut by 50% or more.

Kennametal also is teaming with BlueSwarf to optimize cutting tool action on machining centers. By taking a "digital fingerprint" of the machining center's spindle vibration, the BlueSwarf technology is able to balance the harmonics of the spindle setup with those of the cutting tool and toolholder. Finding this "sweet spot" can improve metal removal rates from 30% to as much as 200%, claims Tim Fara, Kennametal's global market segment manager for the machine tool industry.

The BlueSwarf solution was developed to eliminate chatter and vibration, the traditional nemesis of the machining process, explains David Barton, president and co-founder. The concept was introduced at 2004's Emerging Technology Center and the 2006 IMTS show marked commercialization of the technology in partnership with Kennametal. The marketing target: optimization of new machine tools with the BlueSwarf-powered Kennametal 360 Program.

**Smaller Machines -- Bigger Payoffs**

At his micro-machining exhibit booth Andrew Honegger referenced a philosophical similarity between conventional milling machines and computer mainframes. "A large machine can be
wasteful for small jobs."

As vice president and co-founder of Chicago-based Microlution Inc., Honegger describes his first showing of micro-manufacturing machines as much smaller, less expensive and easier to use than existing machines. His mantra: small parts should be manufactured on small machines. His new machine, the Microlution 310S, is a three-axis micro-milling machine that can make parts up to 2 in. in size with an accuracy of one micron. The big markets for Microlution are bio-medical and aerospace/defense.

He says the benefits begin with initial cost and lower space (only 2 ft x 2 ft) and minimal power requirements. "If you use conventional sized equipment for parts that are under an inch, you're paying for size and capability that goes unused."

Microlution's specialty is micro-milling machines, but Honegger says the micro concept can be applied to EDM, ECM and laser machining.

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