Digital Solutions for 21st-Century Challenges

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INTRODUCTION: THE NEXT INDUSTRIAL REVOLUTION

Today's digital solutions improve product quality, reduce manufacturing errors and even unlock entirely new process modalities and production paradigms. And as the technologies grow more mature — including the rapid introduction of virtual reality (VR), augmented reality (AR) and mixed reality (MR) — it has become clear these changes do not just constitute an optimization of existing practices. Across every industry, manufacturing is now well into the next Industrial Revolution, one that will be transformative for those shops that take advantage of the rise of digital technology on the factory floor.

In this new digital age, manufacturers navigate the merger of high technology and manufacturing, applying innovative digital solutions on the factory floor as more advanced materials and complex part features find their way into everyday products. These digital technologies not only address the current and future manufacturing challenges, but also many of the issues that existed prior to the digital age and that continue to create difficulties today. Those existing challenges include the skills gap, unexpected equipment downtime, the protection of intellectual properties and continued pressure to increase speed, precision and production.

Many shops still struggle to fill open positions; research by Tooling U-SME found that in the next three years, 99% of manufacturers expect to have difficulty finding new employees with adequate experience, and 43% average 20% or more turnover annually. Digital technologies make complex operations simple, which allow manufacturers to shorten the learning curves for new employees and boost their skill levels as well as increase the overall production output of their existing workforces.

Mazak

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High throughput requires equally high machine utilization, but all production stops when machines break down unexpectedly. Digital solutions can not only lessen the impact of downtime with tools to aid shops in making on-the-fly adjustments to workflow, but they can also allow manufacturers to prevent unexpected equipment downtime altogether. Predictive and preventive maintenance via digital advancements monitor equipment conditions and provide early warnings of impending problems, significantly reducing overall downtime and unexpected downtime alike.

Unfortunately, the number of difficulties created by mechanical problems may soon be dwarfed by digital problems. Make UK, an association of manufacturing professionals based in the United Kingdom, found that nearly half of all the country's manufacturers had experienced a cybercrime, with 24% reporting serious losses from cyberattacks. Of course, manufacturing OEMs have done more than simply protect their customers from cyberattacks and help simplify systems for less-experienced machine operators. To protect the intellectual property of manufacturers, today's digital manufacturing solutions offer safe and secure connectivity and overall system protection.

These challenges have largely been overcome with the help of pioneering machine tool builders that have pushed digital manufacturing technology. Since the 1968 creation of its first NC lathe, the MTC 1000M, Mazak Corporation has been part of that digital vanguard. Just two years later, the company went to market with its first machining center, the BTC No. 5, and by the 1980s, the company was on the forefront of conversational CNC system development with MAZATROL and its Intelligent Machining Functions. In 2014, to support the continued development of digital technology in the manufacturing sector, Mazak introduced SMOOTH TECHNOLOGY, a comprehensive suite of digital solutions designed to work with a family of advanced machine controls.

CHALLENGES AND DIGITAL SOLUTIONS

When discussing the role of digital technology in manufacturing, many commentators outside the industry speak in terms of the future. Shop owners and machinists, however, need a robust set of digital tools right now. To that end, Mazak developed SMOOTH TECHNOLOGY and its other digital solutions to offer complete scalability across the entire part-production landscape to ensure ease of use, cross-industry skills compatibility and room for future expansion in response to shop growth. As a result, the most common problems facing manufacturers today may be solved with these flexible technologies, as represented by the following scenarios and challenges that take place in manufacturing facilities worldwide.

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Scenario 1: Skills Gap

Thanks to its exceptional machining capabilities and a reputation for turning around highly accurate parts, a job shop has benefitted from booming business. Unfortunately, finding enough skilled operators to cut the parts has only become more challenging, especially as older employees retire and take their expertise with them. And given that many schools no longer offer basic education in manufacturing technology, new employees need more training than ever to learn complex subjects such as G-code or metalcutting physics — training this shop does not have time to provide if it wants to keep parts moving and customers coming back.

Mazak's Solutions

- **MAZATROL** — An industry-leading programming language, MAZATROL bypasses the use of G-code — and the need to train new operators in its use — through conversationally displayed questions concerning workpiece material type, O.D./I.D. dimensions and part lengths, among other queries. Then, according to the input data, the MAZATROL control automatically calculates intersection coordinates and tool index positioning in addition to optimized cutting conditions and machining processes before allowing the machinist to visually check the tool path and verify the program.

- **SMOOTH MPP** — The Multi-Pallet Pool system is a space-saving palletized automation solution for manufacturers such as job shops that are unable to accommodate full-size linear automated pallet systems but want to improve the output of their existing workforces. The associated control software, SMOOTH MPP, further improves the system's productivity with smart capabilities such as predicting necessary tools and production output according to the production schedule. For easy utilization analysis and real-time workflow optimization, pertinent information is provided for the user in a variety of graphical formats.

- **SMOOTH CNC Intelligent Functions** — MAZATROL SmoothG and SmoothX controls come with such software packages as Smooth Corner Control, Intelligent Thermal Shield, Active Vibration Control, Intelligent Performance Spindle and Intelligent Maintenance Support, which take advantage of the control's powerful hardware to speed up cycle times, ensure accurate machining and prevent unexpected downtime, all while aiding operators in programming and performing complex machine operations and movements.

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smartphones, tablets or laptops. Users view the status of machines and their in-progress workpieces from virtually anywhere at any time — including the ability to manage and edit tool layouts and data — for easy access to the tools needed for unmanned lights-out production paradigms.

Scenario 2: Unexpected Downtime

The speed and quality required by the automotive industry for its suppliers have driven manufacturing technology forward for decades, and a successful manufacturer has achieved this level of throughput and quality control with well-organized production lines and increasingly automated processes. Unfortunately, when one machine goes down, it can quickly take down an entire line — and with fewer operators responsible for more parts, taking too long to identify the problem can impact the efficiency of the entire facility.

Mazak's Solutions

- **SMOOTH Tool Management** — SMOOTH Tool Data Converter and Tool Management help shops keep track of tool utilization at the same time they ensure easy management of tool data, even across a large facility. With SMOOTH Tool Management, users can track tool life for reduced downtime and improved resource utilization.

- **SMOOTH Monitor** — A nearly real-time machine monitoring solution, SMOOTH Monitor allows users to easily keep track of the entire manufacturing environment, making it easier to eliminate bottlenecks, optimize processes and forecast maintenance-related tasks.

Scenario 3: Cybersecurity

After investing in advanced manufacturing technology — especially new machine controls capable of handling highly complex parts and machine connectivity solutions for even greater levels of process optimization — a shop is approached by a defense contractor with a big new project leveraging the new machines. There's one big problem: As a classified project, the shop must meet strict Department of Defense (DoD) requirements to be involved, including stringent cybersecurity regulations that will prevent malware but conflict with their new machine network.

Mazak's Solutions

- **MTConnect®** — An open, royalty-free manufacturing communications protocol based on widely used XML and HTTP technology, MTConnect fosters greater interoperability between manufacturing devices and software. By connecting diverse equipment with a single method of communication, MTConnect makes it possible to monitor and harvest data from the entire production floor, including machines, cells, devices and processes.

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- **Mazak SmartBox** — The Mazak SmartBox provides connectivity for machines and devices, which enhances monitoring and analytical capabilities in addition to preventing malware from infecting the network. It uses a virtual local area network (VLAN) to provide cybersecurity capable of meeting the needs of manufacturers who must meet stringent security requirements.

Scenario 4: Speed and Precision

After building a reputation for its high-quality medical industry parts, a shop has experienced explosive growth, and with that growth have come new challenges. Despite expanding as quickly as possible, the shop's customer base has broadened even more rapidly. The only way to keep up with the pace of production necessary to fill and ship orders in a timely fashion is a high-mix/low volume (HMLV), just-in-time production strategy and an aggressive approach to optimizing processes whenever and however possible.

Mazak's Solutions

- **SMOOTH TECHNOLOGY Advanced Programming** — In addition to Performance Functions such as High Gain Feed Forward Control, Smooth Corner Control, Fast Rotary Axis Speeds, Variable Acceleration Control and Intelligent Pocket Milling, SMOOTH Machining Configuration offers touchscreen sliders that give operators the ability to adjust and save details that can affect machining results, such as cycle time, finished surface quality, machining shape and more. This is an especially effective tool for complex workpiece contours defined in small program increments.

- **Mazak SmartBox** — Because each SmartBox is built around a Linux PC, the microapplication possibilities are virtually endless, especially given the speed of so-called edge computing, in which data are analyzed within the secure VLAN. If a sensor exists to measure data in a machine, it can be incorporated into the SmartBox data collection routine.

Scenario 5: Advanced Production

To succeed in the aerospace industry, a manufacturer must meet incredibly high standards of quality and precision in some of the world's most advanced materials despite increasing levels of regulatory oversight — and its customers still demand finished parts at a faster pace every year. To stay competitive, this shop needs the technology of tomorrow today, including best-in-class tools, automation and machines. And to make all that technology work together, they need outstanding digital systems.

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Mazak's Solutions

- **SMOOTH Set and Inspect** — Developed in conjunction with Renishaw, this part inspection software handles metrology and compensation, including on-machine work measurement and inspection, through intuitive touch panel operation.

- **SMOOTH Volumetric Compensation** — Designed to offer more consistent positioning for high-accuracy machining, SMOOTH Volumetric Compensation allows users to error map machines by controlling six degrees of freedom on the machine axis with the use of an XM60 laser system.

SUMMARY

With the rise of digital technology, many shops face greater challenges than ever before — and the possibility of more effective solutions and efficient manufacturing technology. The merger of high-tech solutions and manufacturing technology enabled by such platforms as Mazak's SMOOTH TECHNOLOGY and its wide range of digital solutions not only provides methods by which shops can ameliorate the challenges of manufacturing in the 21st century, but empowers machine operators and engineers to develop newly optimized processes that help them improve their competitiveness and reach unsurpassed levels of productivity and cost efficiency.

About Mazak

Mazak Corporation is a leader in the design and manufacture of productive machine tool solutions. Committed to being a partner to customers with innovative technology, its world-class facility in Florence, Kentucky, produces over 100 models of turning centers, Multi-Tasking machines and vertical machining centers, including 5-axis models. Continuously investing in manufacturing technology allows the Mazak iSMART™ Factory in Kentucky to be the most advanced and efficient in the industry, providing high-quality and reliable products. Mazak maintains eight Technology Centers across North America to provide local hands-on applications, service and sales support to customers.