

MRO for HRCs: When to Maintain, Rebuild or Replace Horizontal Machining Centers

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Many machine tools are built to last. However, there comes a time in every machine tool's life when something needs to be done to improve its operating ability.

Let's examine some of the decisions shops need to make about aging horizontal machining centers (HMCs), including heavy maintenance, upgrades, rebuilds, and replacing the machine with a new model.

The first thing that needs to be said about caring for horizontals is also forgotten far too often: You should do preventive maintenance (PM) from the very beginning. Machine tool builders provide guidelines. Sometimes, as is the case with Doosan Machine Tools America, Pine Brook, N.J., there's literally a chart on the machine. Naturally, these schedules vary depending on how much you're running the machine, but even a single-shift job shop with a new machine needs to pay attention to PM, said Ragen Hunsucker, service manager for



Illustrating the importance of preventive maintenance, a Methods support technician performs a diagnostic test on a KIWA KH-4500kai. (Provided by Methods Machine Tools)

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added, many companies experience a “power struggle between maintenance and production,” and the need for “parts, parts, parts” wins out to the point that they do no maintenance for years.

To their credit, most major machine builders and their distribution partners offer to perform PM for their customers, but adoption is spotty. Jeff DeLaughter, owner of Machine Tool Specialties, said bigger corporations are more likely to sign a PM contract, though production demands can still make it a struggle to actually schedule the work. And as far as mid-sized and smaller shops, the number following a recommended maintenance plan is “nearly zero.”

Bernie Otto, director of technical support at Methods Machine Tools Inc., Sudbury, Mass., said there are two types of customers who sign up for PM programs. The first is a company that didn't have one and was “burned too many times” by expensive machine breakdowns when they could least afford it. The second is a company that recognizes up front that “they are managing unique pieces of equipment that are hard to replace,” especially if they need these machines to produce at higher levels. He cited one Methods customer who cuts a very abrasive and uncommon material on a specialized machine that must be kept running. “They invest in a consistent preventative maintenance program. Every six months we clean the areas around the ball screw and guideways, check lubrication flow, and check overall machine functionality.”

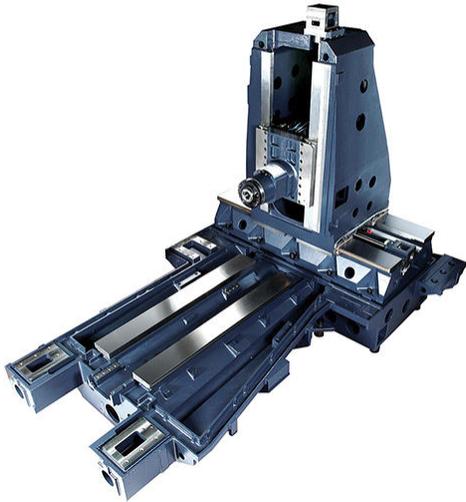
Otto observed that the pandemic pushed many maintenance technicians to retire early. “So we are seeing an increase in service contracts because [customers] don't have any maintenance people left,” he said. “All the old guys retired. Newcomers might put way lube in the machine, but at Methods, we're gearing up to do more complete programs. More and more customers are starting to realize that if they get their service structured and organized, they can plan downtime better. We can fix many more small problems up front before they become really big problems.”

Tasks and Tests as your Machine Ages

Doosan's vice president of service, YB Lee, pointed out that a high percentage of HMC users run 24/7, or close to it, with high standards for uptime. Lee divided routine maintenance into quarterly, bi-annual, and annual tasks, with the latter being things like pulling the way covers and



spindle runout.



The “core” of a Doosan NHM HMC. Boxways offer superior stiffness and vibration dampening, making them popular for heavy-duty cutting, but they require more maintenance than linear guideways. (Provided by Doosan)

Hunsucker said once an HMC has about 10,000 hours on it, Doosan also starts using a megohmmeter to detect possible breakdown in the motor windings or cable degradation (breakdown of the insulation in the cables running to the motors). He also cautioned that boxways require more attention than linear guideways. “With linear guides, it’s not quite as critical to pay

attention to the ways, the lubrication system, the oil distributors, and that type of thing as you would on a boxway machine.” But boxways offer superior stiffness and vibration dampening, making them popular for heavy duty cutting. (Doosan offers both types of HMCs.)

If you’ve kept up PM, and barring any obvious component failures, how do you know if it’s time to consider a major overhaul, or perhaps replacing an HMC? Bill Malanche, COO for Mitsui Seiki USA, Franklin Lakes, N.J., said it’s not something you can realistically schedule. Instead, “machine downtime and scrap rate are probably a better indication of how the machine is doing,” he offered. “Of course, bad parts can be caused by a number of factors, but if you have a tried-and-true production process and you are starting to see deterioration in things like straightness, perpendicularity, and accuracy of components, then you have an idea that something is starting to fail.”

Otto echoed exactly this point, saying “in many ways, the workpiece is the pulse of the horizontal machine. If you see inaccuracies in your parts, or you’re getting bad finishes, that’s usually an indication that the machine is having some troubles. It could be anything from just a worn-out component like a linear guideway. It could be deteriorating Turcite on

“There are a few straightforward tests most machinists can perform to narrow down the area which may be causing the trouble,” he continued. “For example, “put a tool in the spindle, take the keys out, and rotate it to see if you have any play in or out on the machine, which could indicate that the drawbar is getting weaker. Some people even put a screwdriver in the spindle to pry it a little bit. If it does move, the drawbar springs are probably worn out.”

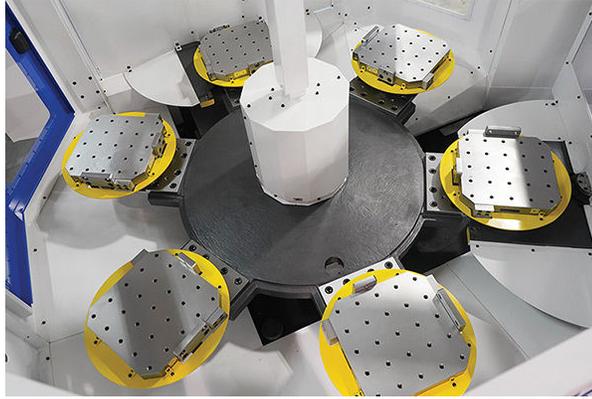
Another simple test is to attach an indicator to the spindle and then touch off on the fixture while trying to manually move the pallet. “If it does move, most likely you have backlash in one of your axes and you’ll probably have to call a service person.”

Along the same lines, Hunsucker said a regular ball bar test is a fast and easy method of “catching accuracy problems before they occur, or as they are gradually occurring.” And, for better or worse, it’s easier to convince a customer to do a periodic ball bar test than to sign up for PM. After establishing a baseline, the periodic tests provide snapshots of the machine’s geometric accuracy. At each stage, the customer can judge if the degree of error is acceptable or cause for concern. He might decide, for example that although the machine is moving out of tolerance, he’ll keep running because the parts are still acceptable. On the other hand, an aerospace shop might look at the same data and conclude that the risk of producing bad parts is now high enough to warrant a full evaluation and likely repair work.

If a machine that had been performing well is now unacceptably inaccurate, Malanche recommended hiring a qualified contractor or the machine tool builder to “reinstall” the machine before considering any major repairs like replacing ball screws. “The machine’s been moving back and forth for years and the foundation settles. This causes the machine to torque. We want to release that torque. ... I don’t have to move the machine, but I’m going to release it from the inertia pads, put it back down to where it was, and basically reinstall it, realign it, do a new laser calibration, those kinds of things.” In Malanche’s experience, this solves the problem more than half the time if the errors in question aren’t huge. “For example, take a machine’s been holding tenths for years, you crashed it and now it’s holding a thou. You might be able to fix this with recommissioning.”

Let's say your machine is holding required tolerances, but you need more throughput. Everyone interviewed for this article said upgrading the control almost never makes sense. But Otto, also Methods' product manager for OKK and Kiwa machines, said two other upgrades should be given serious consideration.

"We can field install additional pallet pools to enable the machine to run more unattended hours with a higher mix of parts. And we can add additional tool capacity to a machine so that it can handle multiple parts that are cued up." In fact, Otto said, about 60 percent of Methods' Kiwa and OKK multi-pallet sales are for machines that were originally equipped with a standard two-pallet arrangement. That's because, although shops are often promised a contract for "40,000 parts, the initial order will be for 3,000. Customers have figured out it's wiser to wait before going all in on the bigger automation system."



It's possible to cost-effectively add a pallet pool in the field, like this KIWA KH-4500kai pallet changer, enabling more unattended hours with a higher mix of parts.

(Provided by Methods Machine Tools)

Most horizontals are equipped with two pallets that swing 180°, switching between the work zone and the load/unload station. Methods and other suppliers offer automation options that take additional pallets to and from the load side of the machine's rotary changer. Otto described stand-alone pools with a fixed number of pallets serving one machine, a tower serving one machine (a space-saving approach now becoming popular), and linear systems using a robot to serve one or multiple machines. DeLaughter said Doosan builds its linear pallet systems such that you can add up to six machines over time, "and expand your pallets along with it, as long as you start out with the proper base." And Otto added that "most of these systems have a scheduler, some of which can handle complex challenges in routing diverse jobs."

Otto referenced a customer who received an emergency contract to make respirator parts during the COVID-19 pandemic at the same time

pallet pool for an existing Kiwa KH-45 machine, plus a new Kiwa KH-4500 with another six-station pallet pool. Both machines use the same pallets.

“Within a couple of weeks he went from running about six hours a day, because that’s all you get from an operator, to about 16 hours. He finally got up to about 22 hours a day, lightly attended,” said Otto. “We took the exact same jobs, speeds, feeds, everything he did before. All we did was add two pallet pools and that extended his days and doubled his production with the same number of people.”

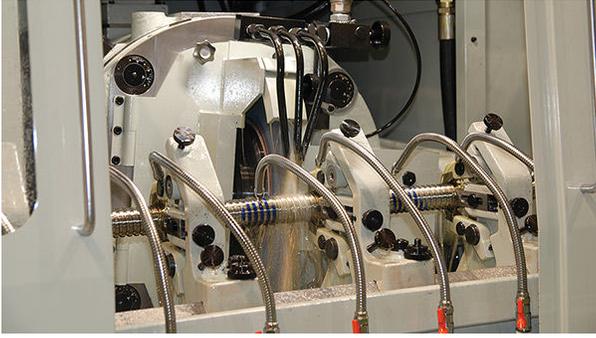
Increasing unattended machining often requires boosting the capacity of the automatic tool changer, especially if you’re automating a variety of jobs. Otto explained that “different manufacturers have different ways of expanding their tool carousels,” and some are designed to make it easy from the start. For example, Methods can simply add magazines to an OKK machine, and in some cases go from 60 to 170 tools. “We can field retrofit a Kiwa’s toolchanger from 120 to 240 tools in about a day and a half.”

Otto suggested several other upgrades that often prove cost effective, such as adding a probe (for easier, automated setup), and a mist extractor for improved health and safety. Improved coolant filtration and a chip conveyor might also be in order if you’ve increased throughput. And “software upgrades for monitoring tool loads and things like that” can be very helpful.

Tough Call: Repair, Rebuild or Replace?

If your HMC has a major problem, you face a difficult choice: repair it, rebuild it or replace it? And it’s not purely a question of the cash cost for each option. For one thing, even if you can rebuild the old machine for significantly less than a new machine, you have to consider what you could be using that space for and the benefits the newer technology would bring.

Klaus Miller, vice president of sales at Absolute Machine Tools Inc., Lorain, Ohio, reported that many customers are replacing 15 to 20 year old HMCs because they’re worn out and much slower in every respect than newer technology.



Mitsui Seiki makes its own precision thread grinders and produces its own HMC ballscrews, helping assure the longevity of these critical components. (Provided by Mitsui Seiki USA)

spindles capable of running only 8,000 to 10,000 rpm,” said Miller, “versus today’s integral spindles running at 15,000. Tool change time on the older machines is probably five to six seconds—at least double what you’d see today.”

What’s more, customers are often forced to further reduce speeds on the older machines. “I have a lot of customers running their 15-20 year old machines at half rapid because the machine can’t take full rapid anymore.” On top of that, said Miller, “the older 400-mm horizontals were pigs, they were huge. Big and boxy, a lot of sheet metal, with a toolchanger built off the side and a chip conveyor extended off the back an extra five or six feet. Now everything’s all enclosed and really compact.”

Lee said Doosan HMCs are designed to operate 40 hours per week for 20 years without requiring a major repair, which aligns with the job shop market. “But,” added Lee, “horizontal customers often run 24/7. Those customers will need major repair work in five to seven years.” Yet even after only five years, Lee pointed out, they can increase their productivity by 15 to 25 percent—or as much as 30 percent depending on the application—by getting a new machine. Thus a high-volume customer, who likely also has high standards for required uptime, should replace a worn machine. On the other hand, said Lee, they have job shop customers who have been running their HMCs for 40 years. “So it depends on the utility,” he said.

Malanche noted that Mitsui Seiki machines are built to last 75,000 hours. He recalled visiting an automotive customer who owned 25 machines but didn’t keep any beyond five years.

“He really liked our equipment and was extremely satisfied with the uptime, reliability and part quality. But he told me flat out that the idea of having any machines taking up floor space in his facility for more than five years, regardless of their condition, was impractical. The gentleman

tool capable of doing, say, 40 mpm in rapid traverse rate today, would be capable of doing 60 mpm in five years. So the output from the machines taking up floor space was going to be increased just by advancements in technology. Why have machines producing 100 percent of the parts needed if you can have the same number of machines producing 133 percent?”

There are some arguments for repairing or even rebuilding an older HMC. First, if the machine is solid but needs one specific repair (e.g., a ball screw replacement), it might very well be worth doing. If removing and replacing the machine would be extremely disruptive, it might be better to rebuild it on the shop floor. The same holds true if delivery for a replacement would take too long.

The more expensive the machine, the more attractive rebuilding it appears. As Hunsucker put it, “a boxway machine with a geared headstock ... are hard to replace. It’s fairly costly to redo the ways and the way tape, but it’s also fairly easy for a trained technician. As long as the electronics are not ancient, rebuilding these machines and putting them back in production is a viable option.”

There’s a fourth option, Hunsucker added: repurpose the machine. For example, if a machine no longer maintains tight tolerances, you can still repair it enough to keep it running and use it for roughing.

Finally, if you’ve decided to invest in new technology, ask about a trade-in. If your machine isn’t a total wreck, your friendly local distributor will find a new home for it, and you’ll save some money on the new machine. DeLaughter said they take a machine in trade about half the time.

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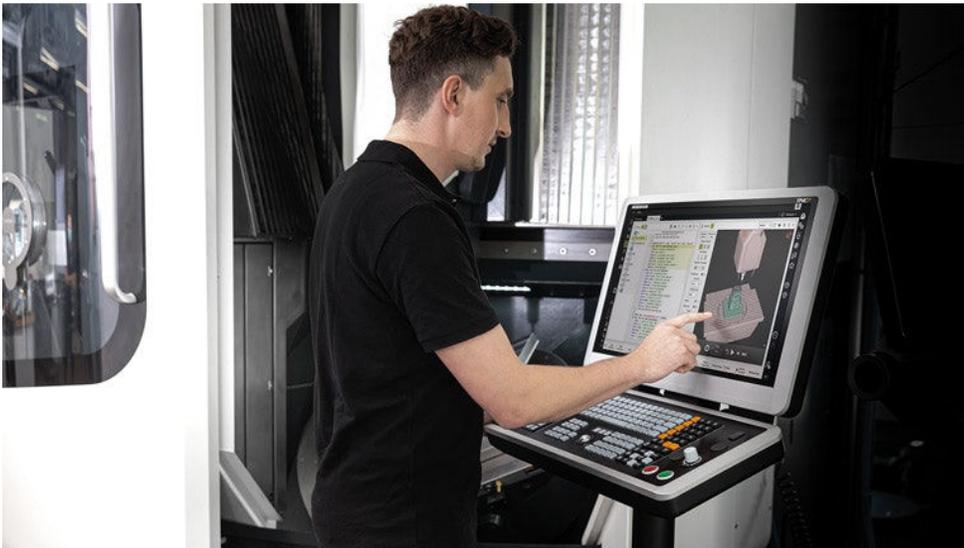


SMART MANUFACTURING

Collaborating with Robots

Between “Blade Runner,” “Terminator,” “The Matrix” and other blockbuster movies, Hollywood has painted a frightening picture—one in which intelligent machines attempt to destroy humanity.

By Kip Hanson



PRODUCT DESIGN & ENGINEERING

Machine Learning for Machine Tools

Heidenhain’s Integrated Process Monitoring learns the speeds, feeds and torques experienced by each axis throughout a cut in producing a good part, and then tracks and displays any deviations for analysis and adjustments thereafter. (Provided by Heidenhain.)

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TOOLING & WORKHOLDING

Machine Tools for Toolmakers

Shown here: OPS Ingersoll's Eagle V5C, a "high-speed, ultra-rigid 5-axis vertical machining center (VMC) with enhanced cooling controls." (Provided by MC Machinery.)

By Kip Hanson



LASERS

Leading with Light

A part sorting system is designed to pick and place cut blanks in a way that best suits downstream operations. Since the introduction of the high-powered fiber laser, the focus shifted from cutting speed to overall part flow, including what happens to parts after they're cut. (Provided by Bystronic Inc.)

By Kip Hanson



AUTOMATION

Modern Workcells Flex Greater Capabilities

An operator with part at Mitsui Seiki 5-axis VTX 55X vertical machining center on the shop floor at LA Gauge Co. (Provided by Mitsui Seiki).

By **Brad Marley**



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