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The successful selection of a parts inspection system depends on thorough research and a willingness to invest.

Upon Closer Inspection

BY RICH DZIERWA, EDITOR

Test this premise out in your head: Your customer is a Tier 1 supplier to a Big Three automaker. It's getting pressured by the automotive giant to redouble its quality-assurance efforts. The customer passes these stringent requirements on to you. So what do you do?

Well, after you freak out a minute or two, your next step should be to review your inspection processes, including an assessment of your parts inspection equipment and its suitability to your future business needs.

Take the case of Knowlton Machine Engineering, Gorham, Maine. Knowlton makes form dies for a company that produces automotive heat shields for DaimlerChrysler. Knowlton's client upgraded its inspection processes a short while ago with the installation of its first coordinate measuring machine. Not long after, that customer decided it was a good idea for Knowlton to match its CMM-based quality verification.

"It's tough to justify the expense of purchasing a CMM, because the machine doesn't make chips," Knowlton's CNC application engineer Michael Deren explained about his company's initial trepidation. (Deren is also a regular columnist for CUTTING TOOL ENGINEERING.) Nevertheless, Deren investigated his firm's options. As that process went along, he found additional reasons for adding CMM technology to his shop floor. Cost justification became easier.

Knowlton's experience isn't unique. Many a job shop has found itself forced in one way or another to add CMM, laser or machine-vision inspection technology to its operation. Many more will in the future.

Axila

Portable CMMs are gaining in popularity. Here an Arm100 system from Axila Inc., is used to measure a base plate off of an automatic flats machine. The shop also uses the CMM to measure welding fixtures and conveyors.

Of the three types of inspection technologies, machine vision provides the most comprehensive "look" at a machined part, sometimes while it's right on the workholder. For overall value, however, it may not match up with CMMs or laser systems for many job shops. Various versions of laser systems don't require parts to be locked in place for comparison to programmed measurements.

CMMs do. With the addition of articulated arms, most CMMs facilitate large-part measurement and on-fixture inspection. Many laser systems don't. Vision systems and CMMs can measure parts of all shapes. Most laser systems are limited.

Given all this, it's imperative to remember two things: Know your application needs and don't skimp on your investment.

Be A Know-It-All

"You have to know what you need done in your facility," said Barb Schutte, inspection supervisor at the Shakopee, Minn., plant of outdoor equipment maker The Toro Co. Schutte recently helped specify the purchase of a laser inspection system for checking some 1,400 parts produced on a laser cutter. "And you need to know how you can support what you end up buying," she said. These aren't always such cut-and-dried matters.

Shakopee previously used calipers, a height stand and micrometers to measure flat parts for lawnmowers and snow throwers. It also used a CMM, but those methods hindered productivity. Improving the inspection system was imperative, as the plant supplies parts to Toro's final-assembly operation on a just-in-time basis.

"Once we make a part, everything must be done to make sure it is out our back door and to the main plant right away," Schutte explained.

The company purchased a laser inspection system from Virtek Vision International Inc., Waterloo, Ontario, and is in the process of programming into the system all the parts it manufactures. Many of those are brackets for lawnmowers and snow throwers. Part programming for first-article inspection takes about 10 minutes. Thereafter, verifying part quality takes 2 minutes. A certificate of conformance for first articles can be output in 10 minutes. Previously, that took 4 to 5 hours to manually generate.

No longer does Shakopee have to spend time fixturing its flat parts that are less than 1" thick for inspection. Now, they're just laid onto a glass scanning table and a single laser, positioned overhead, scans the part, collecting data.

The very thing that disqualifies the Virtek laser inspection systems in some applications makes it suitable for Toro: Parts need to fit on the scanning glass. (Virtek's largest scanning table accommodates parts no larger than 48" long × 48" wide.)

Even after the purchase of its new laser system, Toro continues to use its CMM to measure nonflat parts, accepting the fact that each newly produced part must be fixtured exactly as was the

Measuring on the move

In some parts-inspection applications, manufacturers might find the fixed answer to their needs is a portable device.

These CMMs and laser systems often fit into medium-size carrying cases. Some CMMs may have articulated arms that allow measurement of parts still attached to their fixtures.

"There are some applications where I think a portable CMM would be invaluable," said Gregory Gay, president of G.S. Quality Consulting, and chairman-elect of the Inspection Div. of the American Society for Quality. "For example, you can take one of them onto the tarmac of an airport and check engine cowling sizes. I believe they are also being used for physical machine set up."

Michael Deren, CNC applications engineer with Knowlton Machine Engineering, recently considered a portable device for measuring form dies and machined parts produced by the company for which he works. He opted against it and bought a full-size, stand-alone CMM. "I found the tolerances left a lot to be desired for our type of use," Deren stated. "You're looking at ±0.005" or so on the arms of the portable units. We're into the 0.0001" range and millionths. We probably could have saved 50 percent, but we wanted something more accurate."

In researching the category, Deren wasn't convinced articulated-arm CMMs were suited to his company's needs. "Those hollow-tube arms are made out of aluminum. Under varying temperature conditions, I was concerned they would experience physical changes in the thousandths. For a job shop environment like ours, I felt a free-standing CMM was the best way to go."

The Laser Tracker II portable laser inspection machine from Automated Precision Inc., Gaithersburg, Md., maintains an accuracy of 0.001" on large objects—even 30' long. An operator takes a hand-held probe to a point somewhere adjacent to the object to be measured. The machine will then emit its laser beam. Once the beam is "captured" by the probe, the machine will automatically follow the probe via motorized function as the operator measures the part.

The company does sell probe attachments for measurement of smaller items, but such application is really more suited to CMMs. Roger Wells, Automated Precision's director of new business development and product manager for the Tracker line, added, "Parts with a lot of hidden points would not be appropriate for Tracker either."

Primary applications for the Laser Tracker II are in the aerospace and automotive industries.

The Orbital, a first-of-its-kind 8-axis portable CMM from Axila Inc., Farmington Hills, Mich., weighs only 10 lbs. Its accuracy in measuring parts up to 20' is 0.0059". In adding on the company's Arm100 articulated arm, accuracy is improved to 0.0027" for measuring an 8'-dia. envelope.

—R. Dzierwa

first-article version when dimensions and tolerances were programmed into the CMM.

"Our CMM is very hard to program," Schutte said. But the quality of the inspection process is indisputable.

Knowlton's Deren confirmed that. The form dies that it fabricates for the heat shield maker have numerous contours. "The only way to really inspect these parts is to use a CMM," Deren stated. "There isn't a straight surface on these things."

Knowlton's research into selecting a CMM took many months.

"We weren't sure at first exactly what our needs were, except that we wanted a unit that could handle big parts," said Deren.

Ultimately, the company purchased a refurbished Brown & Sharpe CMM, saving about $40,000 vs. the price of a comparable new system. With it, the job shop is verifying form dies but also checking dimensions of one-off parts it makes for customers. The CMM also gives the firm the ability to design and reverse-engineer. Deren stressed these capabilities were part of early planning.

"If you don't do your legwork, you're going to get screwed," he bluntly warned.

"Buyer beware" is how one quality-control manager for a machine shop described his approach to purchasing CMMs. "When you look at a demonstration of any of these products, they always look great," said Steve Bacon of Magnus Precision Mfg. Inc., Phelps, N.Y., a maker of components for manned spacecraft, missiles, aircraft, inner-body imagers and orthopedic implants. "You can be mesmerized. But it's only when you get into the details of your application that you can conclude if a system is appropriate.

"There is no one machine that will do it all," Bacon offered, "even though most manufacturers will tell you otherwise."

Bacon emphasized that research should focus on internal issues. "What are you going to use the system on? What kind of parts tolerances are you going to be working with? Will the system be located on the shop floor?"

The director of operations at Toro's Shakopee plant, Rick Olson, concurred. "It's important to realize if you see a demo of one of these machines that there's been upfront work to set up the part-inspection files. When you bring the equipment in-house, there'll be work required to reach that level of accomplishment."

On the Laser's Edge

Not surprisingly, manufacturers of laser inspection systems are ever-focusing on their laser technology.

Executives at Blum LMT Inc., Ft. Mitchell, Ky., stress that the design of the laser system in the LaserMicro100 is different than competitive offerings. The system measures ODs and dimensions of shafts, rubber rolls and other cylindrical parts.

The actual stroke for the single-focused laser beam is permanently fixed by a high-resolution linear encoder in the vertical extension of the measuring line. This is said to provide real-time, closed-loop feedback of measurement values.

Paul Meinhardt, general manager, said the machine is ideal for operations with cylindrical grinders and lathes. "It measures highly polished or turned surfaces with equal facility."

General Inspection Inc., Davisburg, Mich., employs numerous laser beams in its V-100 gaging system for high-volume fastener and screw-machine-part manufacturers. The system measures parts' features as they enter a "viewing" field. The company keyed on sharpening the beam of the lasers.

Mike Nygaard, president, said that was a critical issue because, when it comes down to it, garbage in equals garbage out.

"If the laser's line is bigger than 0.004", the image could be distorted," Nygaard said.

Using patented optics, General Inspection's engineers developed a laser beam with a width of 0.004".

The company also incorporated controls that allow the machine to automatically position the laser to be perpendicular to the centerline of parts' axis of travel. This eliminates cosine errors, which can cause measurements

Del Rohloff, a quality assurance technician at outdoor equipment maker The Toro Co., uses a magnetic gripper to place a part onto the scanning table of a LaserQC laser inspection system from Virtek Vision International Inc. A laser projector mounted above the table (inset) casts the laser beam onto the part to capture more than 500 data points per second. Software superimposes the scanned image onto a CAD reference image, and the tolerances are color coded to reveal any variances.

of length, diameter and threads to be inaccurate when checking headed parts such as bolts.

No Bargain

Who among us hasn't lamented a purchase gone awry and mentally reminded himself that "you get what you pay for?" Anyone out there want to spare themselves one more instance of this? Then don't skimp on the inspection system you choose.

"My opinion is that people may be holding back dollars for their inspection equipment," said Gregory Gay, president of G.S. Quality Consulting, Mendon, Mich., and chairman-elect of the Inspection Div. of the American Society for Quality, Milwaukee.

Gay believes this happens with first-time purchases and upgrades of existing systems. He speaks from personal experience. Not long ago, he supervised a retrofit of a CMM system. It cost in the low five figures. The effort greatly improved the shop's capacity and productivity, yet he looks back and second-guesses the decision.

"You think you're saving money, but it may be better to pony up and go state of the art," he offered. "There is significant value to buying one or two deviations on the plus side of the product development curve."

Knowlton Machine Engineering's success with a refurbished CMM may be an exceptional case. The CMM was a system the builder, Brown & Sharpe, itself used in-house. It was upgraded to like-new status, in contrast to systems Gay worries could be "way, way out on the obsolescence curve."

Said Deren, "Some of the used equipment for sale out there is, literally, junk."

Among the most prominent technical evolutions in the CMM realm is the incorporation of direct computer control. DCC allows first-article inspection of a part to be recorded and rerun automatically when ensuing part verification is required.

"If you have a tolerance of ±0.005", even a manual machine will work very well," Bacon said. "When you get into the area of less than 0.001", that's where the repeatability of a CMM with DCC provides a distinct advantage."

No Substitute for Experience

Once, it was considered imperative that a CMM be installed in a room separated from the fluctuating environmental conditions of the plant floor. That has changed. Temperature's effect on parts must not be overlooked when

The following organizations contributed to this article:

American Society for Quality
(414) 272-8575
www.asq.org

Automated Precision Inc.
(800) 537-2720
www.apisensor.com

Axila Inc.
(248) 426-0919
www.axila.com

Blum LMT Inc.
(859) 344-6789
www.blum-novotest.com

General Inspection Inc.
(248) 625-0529
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G.S. Quality Consulting
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Knowlton Machine Engineering
(207) 854-8471
www.kmaine.com

Magnus Precision Mfg. Inc.
(315) 548-8032
www.flowturn.com/magnus

Virtek Vision International Inc.
(800) 684-7835
www.virtekvision.com

Automated Precision

Automated Precision Inc.'s Laser Tracker II, a portable laser-based inspection system (the black, vertical device at left in the main picture), measures a precision cam (inset) for a currency engraving press for the Chinese government. Required accuracy for the cam is better than 10µm. By not having to remove the part from the machine tool for inspection, production throughput was improved more than 200 percent.

measuring them, but room climate and air quality are less critical on machine performance than years ago.

Given this, there is a trend to have non-quality-control personnel—even machinists themselves—operate the inspection systems. This approach must be undertaken with care.

Gay explained that if a person hasn't dealt with inspection nor had significant experience working on the surface plate of a CMM, he may lack the basic knowledge necessary to evaluate information generated by the equipment. "Job shops are giving non-QC personnel top-line inspector responsibility, but I'm not sure those people totally understand the process," he said.

"The skill level," Bacon added, "is not really in the measurement of the part. It's in the person doing the programming." Sophisticated systems, for example, will sometimes automatically enter a tolerance, although the one selected may not be correct. "As software becomes more complex, it is imperative the operator know what the machine is doing, because it can make bad decisions," Bacon said.

Measured Success

As Knowlton's Deren put in the time to research the CMM marketplace, word trickled out that his shop was leaning toward purchasing the technology. Current customers were in favor, and potential customers' interest was raised with the expectation of heightened quality levels. Following the system's installation, Knowlton began doing design work and reverse engineering for clients.

"Besides being a good quality tool for us, the CMM turned into a marketing tool, too," Deren explained.

There's no reason why the same advantages can't be enjoyed by job shops everywhere. That is, if they remember the axiom "The right tool for the job."

When it comes to inspection equipment, this means verify your processes, clarify what systems work well with those and don't be terrified to invest to obtain the best system for your shop.