Managing Factory Data

Barcodes enable manufacturers to store a wealth of information about each part in their inventory, while reducing the chance of introducing errors through manual data entry methods.

Effective data management tools and techniques leverage critical metrics from the shop floor.

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Taking the pulse of the factory, shop-floor data management systems enable manufacturers to effectively collect and analyze factory-floor performance at any given moment. The best data management collection and monitoring systems give factory managers visibility of vital metrics such as overall equipment effectiveness (OEE) that tell them exactly what’s happening in real time on the shop floor.
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The latest solutions for shop-floor data collection and analysis come from enterprise resource planning (ERP) software developers and from shop-floor data collection and analysis specialists. Some newer features include systems that are optimized for use with increasingly popular hand-held mobile devices, smartphones and tablet computers.

“The most important point is to convert the volume of manufacturing shop-floor data into actionable information,” states Jim Abbassian, president, Predator Software (Portland, OR). “For example, say at a given machine a Machine Alarm happens at 11:05 pm and when you get that data, you know that the current critical part number has stopped producing at a bottleneck workcenter for a Tier 1 customer where there is no scheduled third shift. This is actionable information that can make a real-world difference.”

Machine Monitoring Mandatory for Lean

Real-time data collection and monitoring of machine tools for measuring OEE metrics is essential for successful lean manufacturing efforts and critical shop-floor processes, many observers note. Yet in spite of this need for critical data analysis, a large percentage of shops simply don’t have machine monitoring, notes David Edstrom, president and chairman of MTConnect Institute (McLean, VA). Edstrom, who recently gave a talk on shop-floor networking and communication and the MTConnect protocol at the DMG / Mori Seiki (Hoffman Estates, IL) Innovation Days, says that only about 4–5% of machine tools are monitored today. “Running a shop without
remote monitoring is like racing a Corvette in the 24 hours of LeMans without a dashboard,” Edstrom says. “Do you know more about your car than you do about your shop?”

Among nearly two dozen key metrics to be derived from shop-floor management systems, Edstrom listed OEE at the top, with others including asset utilization, diagnostics, statistical process control (SPC), jobs/lot tracking, cell management, inspection probing, machine health prognostics, vibration monitoring, preventative maintenance, energy costs, anywhere-anytime access to plant-floor information, and data mining.

Today’s manufacturing customers are looking for a truly plug-and-play solution, Edstrom notes, which is what has been proposed with version 1.2 of MTConnect, a free, open-source protocol based on Internet standards including Hypertext Transfer Protocol (HTTP) and Extensible Markup Language (XML). “Think of MTConnect as the Bluetooth for manufacturing,” Edstrom explains. “Essentially, it makes machine tools look like a Web site.”

In addition to actionable intelligence, machinists are looking for ease of use from their shop-floor data collection and analysis solutions, adds Abbassian. “Manufacturers are looking for easier-to-use solutions to the complex, real-world shop-floor data problems that they face,” he says. “For example, aerospace manufacturers are merging into larger multinationals, yet they have country-specific ITAR restrictions on certain part numbers and with foreign national employees. We recently developed an ITAR verification process integrated within Predator PDM [document management] and Predator DNC [distributed NC] while simplifying the current process for the machinist.”

Some key features within version 10 of Predator MDC (Manufacturing Data Collection) include the flexibility to integrate any CNC machine, robot, PLC or person-based shop-floor manufacturing data into a unique knowledgebase for that manufacturer, he adds. The Predator MDC offers the flexibility to present more than 25,000 different reports, charts, dashboards and slide shows, he says, and it can also be affordably integrated within a company’s ERP, MRP, MES and other business systems.

Such data management systems can be a boon for manufacturers working to-
ward lean manufacturing goals. “Shop-floor data management, especially with manufacturing data collection, can provide historical perspective on processes to help drive a new lean initiative,” Abbassian notes. “Most manufacturing engineers know where their shop floor is weak, but knowing the cumulative effect to champion change is where we can help. In addition, it can provide the metrics to gauge the ROI or success after the conclusion of the lean initiative.”

Manufacturing Data at Your Fingertips

A fairly recent trend in data monitoring is customers looking for mobile data solutions, notes Greg Mercurio, president, Shop Floor Automations Inc. (SFA; La Mesa, CA), a distributor of Predator Software and other shop-floor data collection and networking solutions. Shop Floor Automations also has partnered with Scytec Consulting Inc. (Greenwood, CO), a custom manufacturing software developer offering a hosted machine tool data collection and process control system. The Scytec DataXchange system includes a configurable Real-Time Viewer dashboard for viewing of shop-floor data with automatic updating.

“We’ve looked at certain solutions that don’t meet all of our customers’ needs and we fill in where the software lacks,” Mercurio says of SFA's add-on software plug-ins developed for applications like Predator MDC and other packages. “We build some customized software for that and sell it as a solution. One of the biggest things now is smartphones and Androids.

“Shop-floor data management in some aspects is like an ERP or an MRP system, which is what I refer more to as an accounting system,” Mercurio notes. “It’s more involved with ‘Here’s what we should be doing; here’s the order, here’s the traveler, here’s the delivery date that the customer is expecting. But the reality is shop-floor data management or data collection, with Predator or even our solution, differentiates us from an ERP and MRP solution.”
“Mostly we are more machine-centric, more concerned about what’s happening on the machine,” he adds, “and so we have the capabilities of tapping into the machine and saying ‘What are you currently doing? Is the machine currently cycling? Is it currently not running because of a certain reason? Is it down because of coolant leaks, or maybe it’s down because of preventive maintenance. Maybe there’s a quality problem or a programming problem as well. From a data-management side, we can actually collect and report real-time what’s happening with the machine, and this can be displayed on some kind of dashboard or on a Web interface. This could be in an office, or across the Web. So the idea is, in real-time, they can see what we advocated—if you put something in front of the operator, they can know where they stand and can be measured themselves.”

Offering operators some feedback with an LCD screen for their machine that is green for cycling or blue for idle, can help make machinists on the shop floor more competitive with each other, he adds. “The idea is to give the operators some feedback, and then obviously management wants to see the utilization of equipment and productivity. We capture the data in real time, and put it all available to everybody.”

The data collection systems also allow historical reporting, Mercurio notes. “That’s important to go back and say ‘How did things perform last week, or yesterday, or over the night
Since all barcode technology uses a pictorial representation to relay data to a computer, it is essentially no different from a keyboard. Barcode scanners translate the information and act as a virtual typist inputting data at the rate of 40-200 characters per second.

When deliberating solutions to introduce barcodes to the quality control department, manufacturers should consider all points of data entry and the amount of information needed at each step of the quality control process. The data capacity embedded in each barcode varies by the technology used—the standard 1-D 13-digit barcode system can produce ten-thousand billion unique codes, but is limited to the 13 characters of actual data input. Two-dimensional barcodes, such as QR codes, can contain about 100 times more usable information.

In the quality control department, application may be considered at any point in the part program: before, during or after it is run. Before running the program, barcodes can be used on job tickets to encode a variety of traceability information related to that job—part numbers, operator employee numbers, operator instructions, and lot numbers. This information can be automatically added to input fields on the inspection report to ensure proper recordkeeping. Barcodes could also be used to identify a part program’s filename to ensure the correct inspection routine is run. Metrology inspection software such as PC-DMIS from Hexagon Metrology (North Kingstown, RI) allows for programmatic data input during an inspection routine and is able to take this information and automatically begin the inspection routine.

During the part program, a company currently using QR codes, or other 2-D barcode technology to label inventory, has the capability of including nominal values as part of the information stored within them. When the individual part or its bin is scanned, the theoretical X, Y, and Z values are instantly pulled. Normally this data is either hard-coded into the software or the operator manually inputs the values. Using barcodes and program input fields, the user interface form can be automatically populated when the code is scanned.

This feature is beneficial to a facility that has several new parts that require parametric programming. Previously, the operator had to manually enter each new nominal value before the program was run. Now the values can be entered into a spreadsheet which is then copied and pasted into a barcode generating program. The resulting barcode is affixed to the part’s bin and contains all required information, as well as the identification of the parts program. A scan of the barcode uploads the data to PC-DMIS and the inspection routine begins automatically.

Parametric programming is a part programming technique that can be used when a “family” of parts exists. The family could fit a set of parameters, for example, all parts are the same shape but different sizes or the same casting with different hole patterns. One master inspection plan is created and can execute a variety of measurement tasks based on parameters that are entered during program execution. The program can be branched or parametrically adjusted via data input which could either be manually entered by an operator or scanned via a barcode reader. Parametric programs often use a customized graphical user interface to simplify operation and increase efficiency and accuracy. Employing barcode technology in this instance would input all the necessary data without any user involvement other than scanning the barcode when prompted.

After the part program is run, barcodes may also be placed on the parts themselves, using labels or pin stamping for example, to include information on measured features. If a concern surfaces at a later date, the component may be scanned and the original measurement information will be revealed. Because of the original data integrity, the scan can also break information down to trace the materials, lots, vendors, machinery, and employees involved with the part’s creation. This is particularly beneficial to the aerospace, automotive, medical or energy industries, where traceability must be documented for safety and recall purposes.

Using barcode technology throughout a manufacturing or assembly facility makes good business sense, and it has been widely used in supply chain management. For companies using barcodes to track inventory, it is a small step to carry it through to their quality control department. Since each facility is unique, expert consultation should be the first step in discussing the potential upgrade. For example, Hexagon Metrology’s applications services group has expertise in barcoding hardware technology, user interface programming, parametric part programming, and typical application of barcoding to the quality control function is essential to a successful project outcome. For more information, contact Shaun Wissner, Software Specialist, at Shaun.Wissner@hexagonmetrology.com.
shift.’ There’s historical reporting and charting available, so that you can tell if a particular part is run on different machines, which machine has better performance? Is it based on machine time? Is it possibly based on a user that’s better trained?” As a general rule, historical performance data is available for a year, after which it’s archived, he adds.

Costs for shop-floor data collection systems, which can be anywhere from $3000–$5000 per machine, can be a barrier to manufacturers implementing the systems, notes Mercurio, and as an alternative, SFA has been offering the Scytec hosted machine data collection, which the companies displayed at WESTEC earlier this year. The Scytec DataXchange can offer machine monitoring for as little as $45 a month, with no large upfront costs or long-term commitments, with the cloud-based data viewable anywhere from an Internet connection. The system requires no servers to be maintained by customers, Mercurio notes, and Scytec writes software add-ons to packages like Predator, and others, to handle the Web-based machine data collection.

“Over the years, there’s always been a large amount of hurdles that shops say they have in implementing shop-floor data collection,” notes Josh Davids, Scytec Consulting president. “A lot of people want data collection and they’re very hesitant. For a lot of smaller companies, and even larger operations, installing database servers and other requirements are daunting.”

With Scytec’s cloud-based system, information is available through the Internet and stored in a data center along with the Web servers, so a customer needs to have only one PC to access key manufacturing data, Davids says. “It’s very straightforward,” he says. “With some of the newer CNC machines with MTConnect, we can set it up without even going there.”
can include machine cycle times; unplanned or planned downtimes; good, rejected, and scrap parts; and OEE data. The system is scalable from small shops with one or two machines up to multiple-plant operations with multiple languages across many time zones.

**ERP Embracing Paperless Efforts**

Along with newer cloud-based systems, another trend in machine data collection with ERP systems is the move toward paperless systems. “Some of the things I’m seeing today is a lot of people want to go green and paperless,” says Richard Henning, president of Henning Software (Hudson, OH), developer of the Visual EstiTrack ERP and shop-floor management software. Manufacturers want paperless solutions that offer the latest up-to-date information from the shop floor, which customers can have with Henning’s Paperless Router, Henning notes.

“The thing about paper on the floor is that if you have a revision you’ve got to go get the paper. Our remote collection for job data is really now giving us the latest options. You don’t have to scan it, it gives you the material requirements and traceability.”

At IMTS, Henning Software also will be introducing the iVET, an interactive shop-floor data collection in Predator Software gives users productivity and cost data on machine cycle times, part production, and other key metrics.
mobile version of Henning’s Visual EstiTrack software. “People are carrying around smart devices these days that have barcode scanning capabilities and Bluetooth connectivity.”

Users can scan a pallet of parts and immediately know everything about it, with the ability to send a message to the inventory system. “We’re now putting together a set of applications that sit up above our ERP systems. It’s another big trend, and these are typically Web-based applications for the iPhone and iPad,” Henning says. “There’s no question that what people want is to have their fingers on the pulse of what’s going on. In my mind, as a developer, this is where things are going. All the new kids coming into the business, they want to run everything by their phone.”

This new class of applications will include touch-first interfaces for mobile devices, he adds, noting the touch-based Windows 8, scheduled to debut this fall, will feature so-called Metro-style apps. “This Windows 8 is so different than any other,” Henning says, noting the system’s touch and gesture-based capabilities.”

Paperless systems are attractive to customers attempting to eliminate manual steps, notes Dave Lechleitner, senior solutions engineer, Exact Software North America (Minneapolis), developer of JobBOSS ERP software. “The big buzzword is talking as much as we can directly to the machine controls,” Lechleitner notes of Exact JobBOSS customers, many of which are in the metal fabrication area. “We find the old traditional way of the black box is still in play.”

About five years ago, the shift was toward more PCs, but the latest move is toward paperless systems and wider use of handhelds, he notes. The company has offered its Data Collection Mobile Solutions for some time, but “to be quite honest, the adoption was negligible,” he adds. “In the last six months to a year, there has been a shift. One customer using an iPad built their own ruggedized case, and others are using more smartphones and tablets.”
For handhelds, a big issue was security, but that has been largely solved, he says, and JobBOSS’ data collection functionality has been rewritten to operate as a Web service. Leichleitner agrees customers now are looking for manufacturing data collection to help support their lean efforts. “That’s one of the things that data collection does. It can help answer questions like where is my throughput? Do I have actionable information on things like isolating bottlenecks, which I think is imperative.”

Startup companies operating with less resources, and companies that have been affected adversely by the downturn in particular need fast, accurate data on their manufacturing systems, he adds. With Exact’s new JobBOSS Starter Edition, the company increasingly is finding more customers at the start-up end of the spectrum. “They expect that they’re not doing anything with pen and paper,” he adds. “For sure, we see a lot of our shops going paperless within even six months.”

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