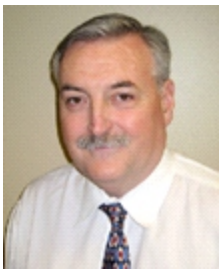
Measure to Improve

Create Actionable Analysis Using Real-time Production Monitoring

MAKINO

Author Bio



James Brown

Director, Digital Technology Development, Makino Inc

James Brown is the director of digital technology development at Makino (Mason, Ohio). He has over three decades of experience in controls software development. Brown is a graduate of Clemson University, where he earned a Bachelor of Science degree in electrical and electronics engineering. He has spent his entire career in manufacturing software development.

Measure to Improve: Identifying Solutions Through Real-time Production Monitoring

With increasing global competition, manufacturers want to optimize machine efficiency and maximize shop productivity more than ever. To get there, they need tools that empower them to accomplish more with less.

Today's factories connect shop floor machines to Ethernet networks for machine program data transfer. The same Ethernet network can monitor machine production in real time.

Thanks to the advent of real-time production software and hardware, getting the most out of a shop floor environment is just a click away. When multiple machines are connected on a single network to a centralized computer, manufacturers can use data-monitoring software to store and analyze high volumes of actionable machine data in real time, eliminating the need for manual data collection.

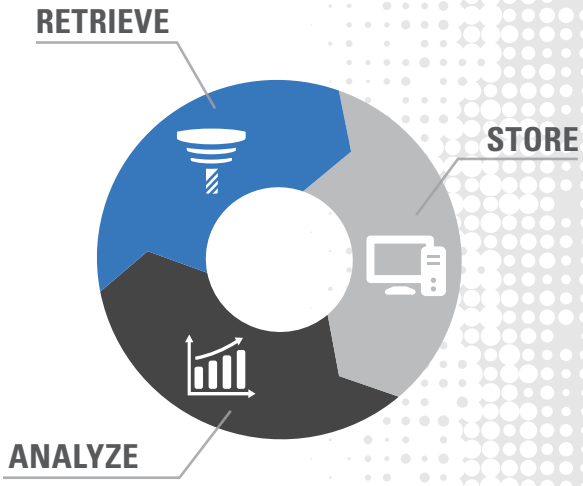
Real-time data-monitoring software works in any shop, large or small. It can provide detail about part counts, cycle time and tool life, and can share production monitoring and status data collected directly from the machines. This software enables shop personnel to react quickly when bottlenecks occur, ultimately preventing downtime. They can reference historical data later to problem-solve or to monitor the need for machine maintenance.

Shop floor network monitoring equips manufacturers with actionable data about a machine's performance—a surefire way to improve their processes. For instance, if a manufacturer aims to produce 10 parts per hour from a machine, it can use data monitoring and data management tools to identify how to boost that productivity. Or, if the manufacturer is aiming for near zero downtime, the data-monitoring software can report any conditions that need attention before a problem occurs.

Data-monitoring software enables manufacturers to stay up-to-date on machining processes even while they're away from the shop floor. They can access their data from anywhere in the world to improve productivity and help a company get the most from its machine investment.

This White Paper Discusses Considerations For Employing Data Monitoring Within These Five Areas:

- Data Collection Capabilities
- Where Data Monitoring is frequently Applied
- Implementing a Monitoring Solution
- Analyzing Data Like a Pro
- Adjusting Processes for Greater Effficiency

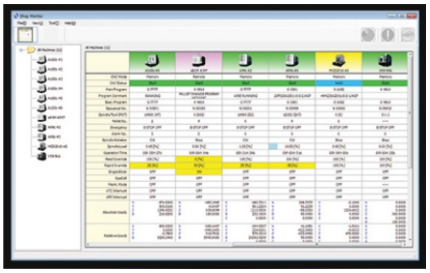


MAKINO

Data Collection Capabilities

Manufacturers can collect a wealth of real-time data from the shop floor—and data management turns that data into actionable results. Armed with data, they can analyze and troubleshoot workflow efficiencies and uptime problems. Personnel can confidently transfer work between machines based on conditions of overuse, underuse and the overall workflow throughout the manufacturing environment.

Standard Actionable Data that Can Be Tracked:



Multiple Machine Status

Displays the state of each machine, specifically whether or not it is running, by displaying "in cycle," "out of cycle" and any alarms - all shown in real time. These alerts are recorded for later analysis. The alarm analysis feature lets personnel retrieve additional information about alarms, including how often they occur.

Machine Utilization

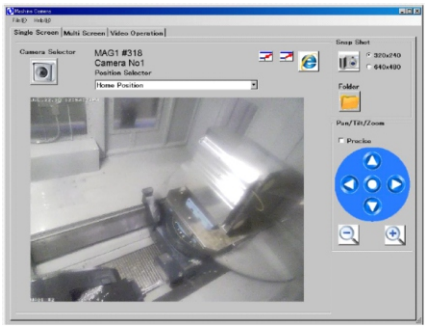
Displays how much time the machine has been in cycle or out of cycle during a specified time period. Also displays spindle cut time (the time the machine spindle makes chips), allowing full efficiency analysis. Keeping track of machine utilization is a key element of real-time production monitoring.

Alarm Status

Real-time data monitoring tracks every occurrence of each alarm on each machine. Personnel can bring up details of an alarm and its history, or see the top 10 alarms that went off in a specific time period. Personnel can also see the alarms that have caused the most downtime. This provides insight into issues with the machine so users can start proactive maintenance for alarms whose frequency have increased over time.

MAKINO

Standard Actionable Data that Can Be Tracked:



Camera Monitoring

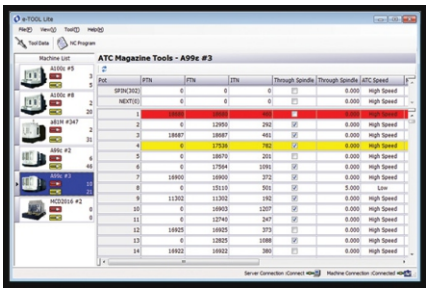
On camera-equipped machines, personnel can capture an internal view of the work zone—making it easier to solve processing errors before they affect part quality, and helpful in the event of repair. Operators and management can use remote viewing to track and respond to processes as they occur, without interrupting other day-to-day activities. A company's IT department can determine the extent of remote network monitoring for personnel based on security protocols, specifically whether to allow it on laptops, tablets or smartphones.

Email Notifications

When a machine alarm activates, e-mail and/or text messages can notify personnel. This feature enables operators to deliver detailed machine status information to their service department, including alarm descriptions and images of the work zone. This information can help them address problems as they occur, and can dramatically improve productivity and process control. Personnel can choose to get notifications in the office, on the road or at home and across a variety of devices. As with all remote communications, a company's IT department typically determines how and where this accessibility occurs.

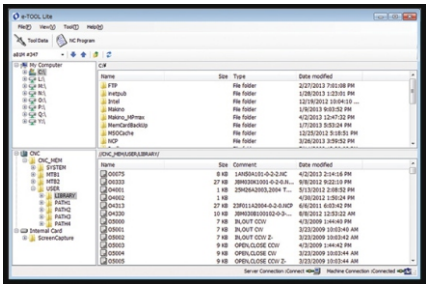
MAKINO

Advanced Features Offered by Select Vendors



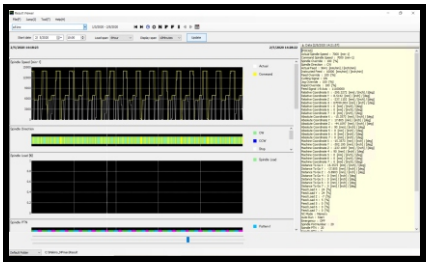
Tool Data Management

Monitors tool length, diameter, offset and alarm data. This actionable data can help maximize tooling life cycle. It also helps the system know what tools are available at each machine. Manufacturers can use the data to find replacement tools before the process stops due to tool shortage.



Work Scheduling

Defines a part as well as the group of NC programs needed to make that part. The remote monitoring system scans the programs and then determines whether the machine has the tools it needs to make that part. If it doesn't, the system notifies the operator and shares what tools it needs.



Result Viewer

Tracks spindle load, axis loads, feed/speed, active program, spindle tool, alarms and other factors related to machine operation. The data is recorded and archived, and users can sort by spindle tool number, alarm number and active program. That way, if there's a performance problem or alarm, the data can lead to accurate resolutions. Additionally, if there is a spindle incident, personnel can see exactly where it happened in the program. Some types of software record the incident to the exact line number in the NC program where it happened, helping the operator easily adjust the cutting parameters.

To access these types of actionable data, choose a provider with expertise in both the software and the machines. Select a software platform that can register, manage and monitor all critical tool data for multiple machines from one centralized location. Some software providers may include visual monitoring tools that help personnel check productivity at a glance.

Manufacturers can connect their software packages to all types of machines thanks to an open-architecture machine communications protocol called MTConnect or OPC-UA. This software is more widely available in newer machines, but can be retrofitted into older machining systems as well.

MAKINO

Where Data Management Is Frequently Applied

Many manufacturing environments use data monitoring—from low-mix automated environments to high-mix automation or stand-alone machines. The aerospace industry uses it to produce critical parts, which require a lot of production monitoring during the process. Real-time data monitoring lets mold makers leave the machine in operation for extended lengths of time. They can leave if needed and check back periodically to verify that everything is progressing as planned.

Data monitoring works with stand-alone machines and with automated systems. Data monitoring in an automated environment means higher utilization than with manually operated machines. In an automated system, it can measure and report productivity down to an individual machine in the cell. If part throughput drops off in an automated cell, the monitoring data can pinpoint the problem. Or, if the data shows that all machines are experiencing the same low productivity, the operator would know that the cause is external to the automated cell, including imbalances in workflow that result in shortages of material feeding the cell.

Machine monitoring gives personnel the opportunity to spot and correct productivity problems or bottlenecks quickly— ultimately yielding more parts per machine.

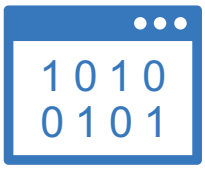
Low-Mix Automation

Stand-Alone Machines

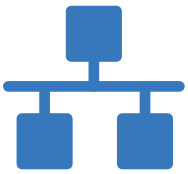
High-Mix Automation

MAKINO

Implementing a Monitoring System



A shop that wants to implement data monitoring must first decide what data to record and retrieve, which helps the software provider give access to the most valued information. Typically, machine utilization data is one of the most requested monitoring services based on its ability to help manufacturers rationalize the ROI of both the monitoring software and machinery. ROI can be calculated by using the current cost per part produced, compared to the number of parts that could be made if more of the available machines had all of their time being consumed.



Once a shop knows what it wants to measure, it's time to implement the software. To install data-monitoring software, machinery must have Ethernet capabilities and the shop environment should be networked. While some shops use wireless technology effectively, others frequently encounter problematic electric fields or other "noise" that can inhibit wireless data flow. Therefore, many data-monitoring software providers recommend that shops implement direct-wired connections to simplify software installation and ensure long-term reliability.

Spindle load monitoring is another highly desired feature that enables manufacturers to optimize spindle speeds, feedrates and cutter engagement for maximum metal removal. Some data-monitoring software provides a deeper look into machining processes to record spindle utilization and efficiencies in the NC program. This actionable data identifies opportunities for operators to combine movements, such as tool change and B-axis rotation, to reduce out-of-cut time for greater productivity. Additional productivity enhancements can be generated from that knowledge.

When installing and configuring the data-monitoring software, it is important to use a supplier with expertise in both data-monitoring and machining processes. There are always parameters that need to be identified and confirmed at the machine, and this is something that a professional should handle. The supplier should also be able to knowledgeably discuss firewall settings and antivirus software with IT personnel to ensure compatibility. During installation of the software, the machines are typically down for about 15 minutes each, in order to allow ample time for setup.

Shop managers should decide how to introduce this tool to their staff. It's best if the data-monitoring software is presented as something that helps make everyone's job easier instead of a "Big Brother" monitoring tool. For example, one aerospace part manufacturer installed a large television monitor at each machine cell to display that machine's productivity. Personnel at each cell then turned productivity rates into a competition with their colleagues, driving a higher level of employee engagement and dramatic increases to the company's productivity and bottom line.

One of the biggest challenges in integrating data-monitoring software is deciding how to store data. Manufacturers should be prepared to archive a large volume of data from the production monitoring processes. The software should offer the ability to analyze this data historically and then archive it from the PC. Some data-monitoring software providers leave this step to the customer. Others assist with training or have an automatic backup utility if a PC crashes.

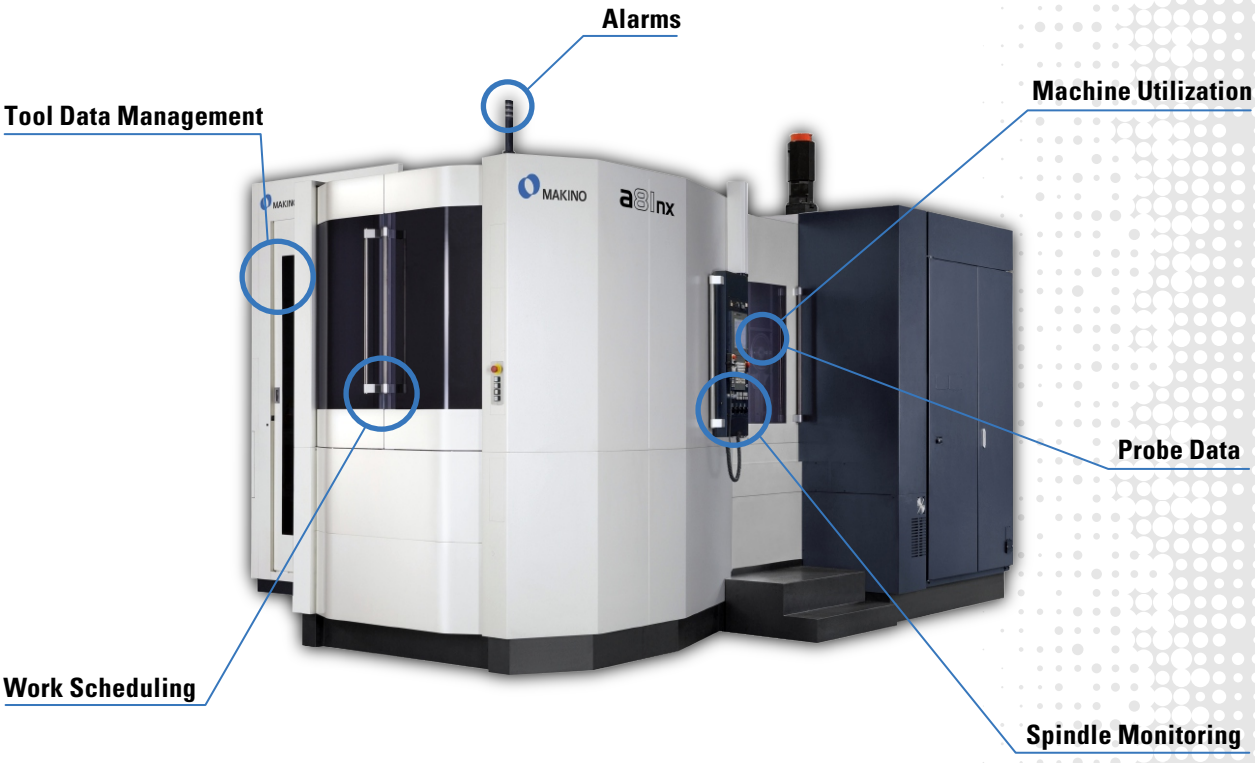
MAKINO

Analyzing Data Like a Pro

Once the data-monitoring software is up and running, personnel can review the data for any bottlenecks or opportunities for improvement. They can analyze machine utilization, alarm histories and machine state to identify why a machine is out of cycle or in alarm, and then correct the issue. In other words, they can catch problems and work through each gridlock, perfecting the processes to achieve optimum workflow efficiency.

For example, a machine may run for an eight-hour shift, and it takes five minutes for each part to cycle. That's 12 parts per hour - or 96 parts in an eight-hour shift. However, the machine produces only 57 parts in that eight-hour shift. The data proves that utilization is off. By analyzing it and checking the machine utilization, the manufacturer can discover what's preventing optimal productivity. Was a machine idle? Was there a material-flow problem? Was feed rate turned down? Personnel might check spindle load monitoring or tool data, or use a tool monitor display that shows alerts when new tools are needed, eliminating potential downtime. Or they could use the tool data to improve the process to achieve better tool life. The data helps the manufacturer find and solve the problem—and improve workflow along the way.

Manufacturers should conduct training to help users analyze the data they collect and to optimize cutting performance of the machine. Initial training typically reviews the features available for analysis and explains how to use the software.



MAKINO

Adjusting Processes for Greater Efficiencies

Once the user collects and analyzes the data, it's time to adjust processes to achieve optimal productivity—either immediately or during scheduled downtime. Manufacturers should stay flexible, ready to change the way machines operate based on the results of data analysis. Many companies have processes they hesitate to discard, even if the data shows it is inefficient. However, they shouldn't fear that the data might steer them in the wrong direction. A thorough analysis of the data leads directly to informed choices and more confidence in the operation than ever before. This actionable data can maximize efficiency and minimize downtime.

With improved efficiency comes better cost per unit, which goes right to the company's bottom line and enables it to expand the operation.

MAKINO

Conclusions

- There is a variety of data-monitoring software available with a wide range of standard and advanced features. To select the right monitoring solution, it is critical that manufacturers choose a provider that offers tight integration between the software and the machines.
- Data monitoring works in many different types of manufacturing environments, including high to low mix and automated or stand-alone machines, and should no longer be considered exclusive to large companies.
- For effective implementation of data network monitoring software, manufacturers need Ethernet capability with wired connections that run directly to each machine.
- The ideal software provider shares their expertise with machinists and IT personnel, optimizes machine settings and processes, and makes networks compatible with company security protocols.
- The way personnel understand data-monitoring software can impact the success of its implementation. It is important for machine operators to view this technology as non-threatening, and as a tool for continuous improvement.
- Manufacturers should be prepared to store large volumes of data. With access to archived machine process data, companies can better track progress and identify opportunities for process improvement.
- Conduct training with the software provider to educate personnel on how to effectively and efficiently analyze data and improve machine performance.
- Companies must be ready and willing to adjust all processes based on what they learn from the data to maximize efficiency and minimize downtime.

Resources

Visit Us on the Web:

www.makino.com

To Learn More, Click on the Links Below:

Makino's MPmax: Real-time Machine Process Control and Data Management >>>

The Functions of MPmax that Assist in Maximizing Your Production >>>

MAKINO