# Digital Factory Integration: Data Enrichment at the Edge

Mazak SMART BOX
CONNECTING YOU TO ENDLESS POSSIBILITIES

Mazak | VIMANA by System Insights | cisco

# Digital Factory Integration: Data Enrichment at the Edge

## INTRODUCTION

Machine tool builder Mazak Corporation and IT leader Cisco Systems Inc. achieved a significant leap forward in full factory digital integration as well as easy and secure entrance into the Industrial Internet of Things (IIoT) with the development of the Mazak SmartBox. As a launch platform, it allows manufacturers to access and use real-time manufacturing data to improve overall productivity and agility along with responsiveness to customer and market changes.

Data drives full digital factory integration. And within that integration exists an area or region known as the "edge" — the boundary between what is considered the physical piece of equipment, the data source and the rest of the networking world. The edge is essentially the IIoT gateway, so the closer to the gateway that data can be processed or enriched, the better.

Enrichment close to the edge reduces the complexity of the source's data stream, or its "digital exhaust," and simplifies it into a form that other applications can understand and utilize. Actual enrichment is the classification and identification of data in terms of what is happening in a process and who is doing it. In the case of manufacturing, enrichment entails information such as when a machine was making a part, who was operating the machine, what was happening while the part was being made and, if the machine stopped, why.

Machine data is complex and, without enrichment, a user would be unable to take full advantage of the valuable digital exhaust from such equipment. In a recent project, Mazak worked with manufacturing software solutions leader System Insights Inc. to make the SmartBox smarter. The companies capitalized on the SmartBox's complete open architecture and gave it the computing power and intelligence to enrich data as close to the edge as possible. With the SmartBox and System Insights VIMANA Enrich software, the companies have taken the next major step in process analytics.

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## MAZAK SMARTBOX DATA ENRICHMENT PROJECT OBJECTIVES

With System Insights, Mazak sought to achieve the following project objectives:

- Give the SmartBox added business logic capabilities and the power to reason over real-time machine data.
- Enrich data as close to the edge as possible.
- Enrich data without the increased cost of additional complicated and expensive software systems.
- Transform the SmartBox from a simple gateway for MTConnect® derived data to one with internal computing power and interoperability capabilities.
- Further improve manufacturing efficiency, particularly with respect to machine utilization and associated downtime for manufacturers via a smarter SmartBox.

## TECHNICAL/TECHNOLOGY APPROACH

There are three key aspects of technology required for data enrichment. The first is the SmartBox and its Cisco® Industrial Ethernet 4000 Series Switch technology that makes safe networking possible at the edge. The second is Mazak's robust, fully featured implementations of the MTConnect standard communications protocol on its machines. The third is VIMANA Enrich software from System Insights.

### MTConnect

MTConnect, an open, royalty-free manufacturing communications protocol, fosters greater interoperability between manufacturing devices and software. The MTConnect standard provides connectivity and the capability to monitor and then harvest data from the entire production floor — machines, cells, devices and processes. The standard makes this possible because it's based on XML and HTTP Internet technology for real-time data sharing.

### Industrial Ethernet 4000 Series Switch

The Cisco Industrial Ethernet 4000 Series Switch offers an industrial machine connectivity solution for a secure, scalable way to connect machines to Overall Equipment Effectiveness (OEE) platforms. The 4000 switch supports the MTConnect open standard that's used to track machine operation, utilization and overall efficiency.

The all-in-one 4000 not only connects machines to OEE solutions, but also provides security and computing capabilities. The switch's technology resolves the problems typically associated with access, management and scalability, thus enabling both IT and manufacturing-operations team members to work together to drive machine efficiency and visibility.





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### Mazak SmartBox

Combining MTConnect and the 4000 switch, the SmartBox provides connectivity of machines and devices for enhanced monitoring and analytical capabilities along with cybersecurity. The unit mounts to the side of a machine without the need for a direct connection to a machine's electrical cabinet. With several standard input ports and connection ports, SmartBox quickly and easily connects any standard off-the-shelf sensors to the system for machine-data gathering and condition monitoring. One SmartBox can serve several machine tools, along with other associated manufacturing equipment, depending on the application.

SmartBox offers network isolation, which prevents unauthorized access from both directions — to and from the machines and equipment on a network. SmartBox also satisfies the critical security concerns of IT departments when connecting legacy equipment to a plant's main network for the purpose of gathering manufacturing data through the MTConnect protocol.

SmartBox is one of many innovative components in Mazak's dynamic iSMART Factory concept, which enables complete digital integration of advanced manufacturing cells and systems to achieve free-flow data sharing in terms of process control and analytics.

Mazak's iSMART Factory concept also incorporates the company's SMOOTH TECHNOLOGY, a complete process-performance technology platform that includes the various levels of the new Mazak MAZATROL Smooth CNC as well as advanced machine hardware and servo systems. SMOOTH TECHNOLOGY represents a key first step towards digital factory integration.

### VIMANA Enrich

Implemented to reside directly in the SmartBox, VIMANA Enrich is a sophisticated software system created by System Insights that analyzes data and understands the behavior of machines within the context of manufacturing processes. It helps manufacturers understand exactly what their machines are doing in real time and why.

This software combines controller data and digital signals with high velocity and complex sensor data streams and identifies patterns in the combined data stream. This allows legacy equipment to provide the necessary process data with the same level of meaning as newer machines — thus removing this burden from other software applications unable to handle high speed data analysis.

VIMANA Enrich instantaneously converts the real-time data streams into information used to drive operational decisions. For IIoT and other complex networking systems, the software attaches meaning to low-level data streams, such as those coming from a machine tool. This means a higher level of business logic flows right out of the machine tool — via data standards such as MTConnect — which makes plugging a machine into an IIoT-type network much simpler. And, because VIMANA Enrich is a real-time processing system that resides at the edge, it allows for a freer exchange among all the other pieces of a facility's enterprise software system.

Within the SmartBox, VIMANA Enrich provides continuous feedback to the resident MTConnect agent using an extended set of data items and vocabulary. VIMANA Enrich combines its process knowledge with the MTConnect data and provides a rich contextual understanding of current processes. In doing so, it paves the way for decision making, where complex analytics and prognostics are used to compare patterns to historical norms, then provide key performance indicators (KPIs) and send alerts when processes are not operating correctly.

## CASE STUDY: MAZAK SMARTBOX BETA TESTING IN THE iSMART FACTORY

Mazak developed the SmartBox for its own manufacturing operations and used its own machines, technology and processes to test and refine the technology. Of the 65 machines, paint test stands and other devices connected through MTConnect at the Florence, Kentucky, Mazak iSMART Factory, the initial complete installation of a machine-monitoring system encompassed one SmartBox, six horizontal machining centers (HMCs) in an automated flexible manufacturing system, three other HMCs in a similar automated system and six large bridge-type milling machines. This beta test section of the plant represented a cross-section of equipment and helped establish a performance benchmark and related training protocols that would easily expand across the entire machine tool manufacturing plant.

A series of 60-inch display monitors presented real-time utilization data in the test section of the plant and cycled through a series of viewable KPI reports. The Cisco switch enabled network isolation, which created a higher level of cybersecurity for enhanced machine monitoring and analytics. The majority of reports focused on a specific machine, as well as performance-based gauges and readouts. Other reports featured graphs that compared all connected machines according to a variety of critical metrics, such as uptime and stoppages by category.

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## PROJECT RESULTS

Almost as soon as Mazak produced reports on its iSMART Factory floor, the company experienced a six percent increase in utilization. Without any other actions taken, these immediate gains resulted from operators simply being aware of how their time management affected machine utilization. To date, efforts to reduce downtime — as based on factory floor report data — have yielded a more than double-digit percentage improvement in machine utilization for the monitored machines. As a result of this windfall machine capacity increase, Mazak reduced operator overtime by 100 hours per month and brought 400 hours per month of previously outsourced work back in house.

But the most significant gain is Mazak's capability to perform predictive diagnostics through monitoring sensor packages on machines and other equipment. Instead of having to reconfigure an entire system's network software (past requirement for incorporating such sensors), the company uses predictive diagnostics through the Mazak SmartBox — that now has the computing power of VIMANA Enrich software to enrich data at the edge — regardless of machine type, model, or age.

Also as a first for Mazak, top management, as well as everyone in the company's iSMART Factory, now has access to the same actionable reports and/or monitored data through mobile devices. Shop floor employees now have easy-to-interpret, visual report formats that give them at-a-glance information about how machine tool conditions are influencing efficiency. Bar graphs that summarize activity across several machines simultaneously inform supervisors and managers of trends useful for decision making and long-term planning, such as when additional operator training may be needed.

The company is now fully aware of program stops, feed holds, spindle overrides, tool changes, and other reasons why a machine is idle. By analyzing collected data, Mazak personnel are able to identify and easily fix such downtime-related inefficiencies to improve overall utilization.

Mazak has also gained a security strategy for individuals outside its facility network as a result of the network isolation the Cisco technology provides. Individuals, such as equipment suppliers, can log on to Mazak's network and have access to only those machines the company permits through the SmartBox technology.

## SUMMARY

The results of the collaboration between Mazak, Cisco and System Insights utilizing the MTConnect standard, represent continued progress toward the total digital integration of factories, where access to real-time manufacturing data — enriched as close to the edge/source as possible — is used to improve overall productivity efficiency and responsiveness to customer and market changes.

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***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 Kentucky iSMART Factory to be the most advanced and efficient in the industry, providing high-quality and reliable products through its Production-On-Demand practice. Mazak maintains eight Technology Centers across North America to provide local hands-on applications, service and sales support to customers.*

***About System Insights***

*System Insights is the leading global supplier of manufacturing operations management software in machining-based, discrete manufacturing and process industries. System Insights delivers predictive manufacturing solutions to improve manufacturing efficiency, productivity, and profitability through the innovative combination of a comprehensive real-time data solution and multi-dimensional, complex reasoning technology.*

*With its VIMANA software platform, System Insights delivers a unique combination of Hybrid Cloud Computing and Big Data capabilities to increase productivity, reduce environmental footprint and revolutionize the economics of machining-based manufacturing.*

***About Cisco***

*Cisco is the worldwide leader in IT that helps companies seize the opportunities of tomorrow by proving that amazing things can happen when you connect the previously unconnected. At Cisco, customers come first, and an integral part of our DNA is creating long-lasting customer partnerships and working with them to identify their needs and provide solutions that support their success.*

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