



EVEN SMALL FACTORIES CAN GET SMARTER

Making your plant smarter **may not be as daunting or expensive** as you think.

Smart manufacturing uses data to deliver value the way automation, mechanical machinery, and labor did in the past. Yet engineers often worry that transitioning to smarter factories involves navigating a deluge of unfamiliar and possibly expensive technologies ranging from the Internet of Things and Big Data to cloud computing and machine learning.

Surprisingly, it may not be as daunting or expensive as you think. When it comes to making your plant smarter, there is plenty of low-hanging fruit.

The payoff could be huge, especially for small- and medium-sized manufacturers who switch their production mix monthly, weekly, or even daily.

By capturing the right type of information, engineers and operators might discover things they might not otherwise notice. Take, for example, machine utilization. In many small shops, lights indicate machine status. Yet they do not show whether the machine is in startup, cleanup, or making parts and money.

A smart factory can tell you all that and more by capturing output and quality data. It can show you quantitative data about which machines are most productive, what tasks they do best, and how different operators compare when running the same piece of equipment. By replacing coordinate measurement ma-

chines with on-tool sensors, you can use real-time data to see when quality starts to drift or a cutting tool begins to dull.

In other words, smart factories give engineers the quantitative information they need to make better decisions. And it costs less than you think.

At NIST's Smart Manufacturing Systems Test Bed, we've demonstrated that we can build a basic industrial IT network (including server, router, switches, and wireless access-points) for about \$3,000. We maintain cybersecurity by not connecting it to the Internet.

Our experience is that most machine tools built over the past 10-to-15 years already have network ports, and many were designed to capture data. You may need to update controllers or software (about \$1,000 per machine if not covered by a maintenance contract) and buy a license to stream data (up to \$4,000). Even so, you could upgrade a 10- to 15-machine shop for only about \$15-20,000.

Many vendors and third parties also provide external networking and sensor kits to upgrade older machines, even if they were not designed for connectivity. Costs run \$3,000 to 7,000 per machine, depending on requirements.

Once you set up a network, collecting data is surprisingly straightforward. The key is to use a standards-based data collection protocol, such as MTConnect, that works with a broad range of industrial sensors and software. Once installed, it can immediately begin to capture data on shop floor utilization and efficiency.

Of course, data is useful only if it tells a story. Fortunately, several companies make commercial dashboard tools that

link with MTConnect. These enable plant managers, engineers, and operators to visualize machine status, overall equipment effectiveness, key performance indicators, and a great deal more.

It is sometimes easy to underestimate the power of these dashboards. Take, for example, overall equipment effectiveness, which gauges productivity by measuring speed, first-pass yield, and downtime. Engineers and plant managers often come to work early so they can calculate that data and provide specific goals to machine operators when they start their shift.

With a dashboard, that information is immediately visible, and engineers can see how it changes from morning to afternoon, or from shift to shift. This not only helps keep operators on track, but also gives engineers better insights into what is happening on the plant floor.

Dashboards do more than display real-time shop status data. They also use that information to predict future performance. Engineers and managers can use this information to plan manufacturing campaigns and product switchovers, and to intervene before small issues balloon into a major crisis.

NIST can help with this transition. Through our Smart Manufacturing Systems Test Bed, we've tested how to fit emerging technologies together to reap big benefits. Our guides and documentation are publicly available at smstestbed.nist.gov and we welcome your questions and comments. **ME**

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