Machining

IMTS 2018: Fact or Fiction? The Promise of Industry 4.0

Don Sears | Aug 29, 2018

When you strip back the hype of Industry 4.0 and focus on the balance of output and quality, the results of its potential promise can be realized. We spoke with a veteran of precision manufacturing and sensor-based metrology technology from Renishaw to understand how Industry 4.0 can actually impact process and part making.

Industry 4.0 will be promoted and discussed at great length at the 2018 ***International Manufacturing Trade Show***. If there is one thing to understand about smart manufacturing and Industry 4.0, it's that many organizations oversimplify how quickly they think they can integrate something meaningful.

Dan Skulan has been working in precision machining and the metrology gauging trade for over 30 years—and knows his way around productivity and quality metrics for manufacturers. As a general manager of industrial metrology for Renishaw, Skulan has a deep understanding of how companies find out if they are prepared to handle the promise of Industry 4.0. Skulan is presenting specifically on Industry 4.0 at the IMTS 2018 conference sessions.

The definition of that buzzword term should focus more on what the specific goals of a manufacturer are than on anything else. The promise of Industry 4.0 depends more on clearly understanding company objectives and using proper techniques and tooling than incorporating any new data management system, according to Skulan.

"You can collect a tremendous amount of data, but data is only valuable if it's accurate and actionable," says Skulan. "There are very valid results that Industry 4.0 can bring, but it's really important that it be implemented in a systematic way starting with accurate and actionable data coming from your processes."

IMTS 2018

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So what should manufacturers do? To start, they need to practice due diligence—and make sure it makes sense. Everyone wants to improve. Automation is important, but it can prove very costly if allowed to run without internal process control to ensure quality is maintained at a higher throughput.

“What if the process that reports to be running has actually created a bunch of scrap or no parts at all?” explains Skulan. “Good process-based systems that verify that the workpiece and tooling are correctly set and cutting programs that are running with inherent accuracy are what is needed. In-process measurements should verify that the right cuts on the right part were made. That is how you help separate the good implementations of Industry 4.0 from the weak ones that simply try to incorporate higher degrees of data monitoring without ensuring the underlying process is in control.”

To that end, Skulan emphasizes the very important role of simulation—but only if coupled with sensor-based accuracy that checks the machining process at key stages right into a machine.

“Our objective is not to just verify that production is taking place, but it is to verify that all stages of production are meeting quality standards with minimum lost processing time,” says Skulan. Here, sensors and automation play a crucial role—but only if the data is verifiably accurate. It’s in the right combination of smart-sensor technology working in concert with software that is readily-available for operators to clearly see on a dashboard that improved productivity is realized.

The Important Role of Simulation and Automation During a Labor Shortage and the Age of Industry 4.0

There are several things driving this golden age of manufacturing evolution. Information technology is a big factor, explains Dan Skulan.

"The ability for us to have self controlling automated processes, then actually watching machining operations in real time through simulation is imperative—it's one of the driving factors," says Skulan. "We can now have a 'digital twin' of a process that has accurate, predictable outcomes."

We're also in an era where manufacturers, workers and consumers want rapid change. Impatience is a driver—and so agility for manufacturers is very important. The automotive industry is an excellent example of today's required agility. Automotive drivetrains can now be completely redesigned in periods as short as six months to keep up with fuel efficiency demands, changes in regulations and consumer demand, explains Skulan.

There's also another major factor: The manufacturing skills shortage—where it's difficult to find almost anyone to work in a climate of near 3 percent unemployment.

"So we need to automate," says Skulan. "We're trying to increase our production rates, while also trying to rapidly adjust to constant product changes. We don't have a choice but to try and get more efficient and use less people because we're trying to produce at higher and higher rates while needing to keep costs in line."

Skulan believes there are excellent career opportunities for employment in manufacturing, but workers need to be trained more as process managers than hands-on laborers. He believes different skills are required now.

"Our educational system must adapt to produce the graduates that meet the requirements of automated manufacturing," he says.

The Danger of Smart Manufacturing: Overpromising the Results of Industry 4.0

But not everyone has the same picture of Industry 4.0. Some companies think it's the holy grail of manufacturing and believe that once they adopt it, it will revolutionize their productivity and drive down costs almost immediately. Skulan says it can make a huge difference, but it's not necessarily the quickly realized promise of results that senior manufacturing management expect it to be.

"Once senior managers buy into implementing a 4.0 strategy, there is an expectation that an instant increase in productivity and quality will take place simply by monitoring shop floor operator performance," says Skulan. "This is a potentially dangerous mindset that some companies are adopting. There is real work that needs to be done at the shop floor level to prepare processes so that the benefits are realized. Industry 4.0 is not a magic wand."

But Skulan is quick to point out that this process—when done well—has legitimate merit in

manufacturing. To help illustrate its importance and its promise, Skulan talks about one of his large customers that is a major aerospace manufacturer with over 250 engineers solely dedicated to Industry 4.0 process and practices. The drive to improve productivity and innovate in the aerospace industry is a major element of its success.

See the success of the aerospace industry in action in our infographic: "To Infinity and Beyond: Aerospace Opportunities in Manufacturing Take Off."

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Industry 4.0 and the Value of Process Control

Measurements of throughput alone are valid—but they can have their own inherent limitations.

Many manufacturers focus a lot of attention on cycle time in their machining—which can help productivity—but it can be misleading. "Machining operations might show high levels of activity, but it could be that the machines are not actually producing good parts or any part at all," says Skulan.

An effective application of Industry 4.0 is one that balances both throughput and quality by using the kind of technology that allows for in-process validation. And all of it should report ongoing information to operators and plant managers.

"Rather than final part inspection, manufacturers should capture accurate information at each stage of the machining process as these processes are occurring, so they can affect change before any nonconformance occurs, ensuring a quality output far upstream in the process," suggests Skulan. This is, in his view, a requirement to realize the promise of Industry 4.0: "We now have the ability to validate quality and adjust for it in real time based on data accuracy. Quality that comes from in-machine automatic process control, using sensors and software together, helps make certain that the information being examined at a management level is accurate and actionable."

"If you look at data after parts are produced, which is what the majority of companies do now, it's valid information, but it doesn't help you change the process," says Skulan. "What you really want is to measure discreet characteristics that are critical to the manufacturing process at each point along the build and the cutting of a component, and take that data using sensors and techniques that confirm it is valid."

The challenge is to determine what are the critical characteristics of a component to measure for process control? In many cases, there might be upwards of 30 features cut in a single process, but likely there are only a couple of key dimensions that are critical to guarantee quality upstream, so it requires a deep understanding of what can be adjusted and monitored in real time

Industry 4.0: The Value of Adaptive Tooling and the Closed Loop Process

If the goal is to take advantage and adapt in the process of machining, then understanding the role of newer, more advanced, adaptive tooling is essential. In the Industry 4.0 world, it also means gaining an

understanding of how sensor and automated probing tools can help report and validate a host of measurement and dynamic machining data. This data includes areas such as dynamic work offsetting, tool center point control and establishing the effective depth and width of cuts by dynamically measuring the effective cutter flight path.

“The evolution that has happened with 5-axis machines and the ability to move parts and tooling at the same time, coupled with in-process gauging can work incredibly well to provide a closed loop environment,” says Skulan.

“In modeling, you don’t want to just simulate what is in the drawing, you want to simulate what actually happens on the machine in this ‘digital twin’ environment,” adds Skulan. “You also need to change your tooling and process methodology to support closed loop process control.”

How do you do that? Skulan brings up an example of using circular interpolation. As an example, instead of using a fixed single point boring tool that has to be set manually offline, the Industry 4.0 method would choose to drive a milling cutter through a circular pattern which allows for gauge-based cutting techniques to be employed.

“One can take an automated cut, removing only half of the stock allowance, then measure the resultant feature using a probe *in process*, at that point in time, in that specific, real-time temperature and exact machining environment—and then update the toolpaths automatically *in cycle*,” says Skulan “This is closed loop control. In this way the process is fully automated and agile.”

To learn more about the promise of Industry 4.0, Skulan is presenting “*Maximizing Manufacturing Productivity in the Information Age*” on Thursday, Sept. 13, at the IMTS 2018 conference sessions. Registration is required.

How is your shop using Industry 4.0 techniques today? Share your stories.

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