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Case Study

Global aerospace manufacturer reduces risks of production disruptions with RFID

CARON ENGINEERING

Customer: Founded in 1986, Maine-based Caron Engineering develops advanced CNC hardware and software solutions to improve performance, productivity and profitability.

Challenge: Provide a way to automatically update specific CNC tool usage history data for a major aerospace manufacturing customer to reduce time and errors of manual data collection and entry.

Solution: Deploy Tool Connect, an automated tool identification and tracking system using a compact, Siemens SIMATIC Ident high frequency RFID system to read and write tool data.

Results: Improved CNC tool visibility, optimized tool usage, reduced risks of production disruptions, while saving CNC operator time and eliminating data-entry errors.

Linking Siemens SIMATIC Ident capabilities to the CNC control and monitoring system improves usage and visibility.

Aircraft components must be precisely machined from the most durable metal alloys, so they can withstand stresses from enormous forces day after day, year after year. Consider jet engines, for example. Able to produce thrust of 60,000 pounds or more, one can have up to 15,000 parts, with the failure of just one causing a potential disaster.

Another example is an airliner's landing gears. They must support as much as 25 tons of weight when landing at 175 mph. Durability must be designed, engineered and manufactured into every part. That's why CNC (Computer Numerical Control) systems play a big role in aerospace manufacturing.

Olden days. Half a century ago, airplane parts were machined by manual operators using a variety of shop tools, such as lathes, drills and grinders. Today, manufacturers use highly automated CNC systems incorporating these tools.

While the roots of CNC systems go back 60 years or so, they became increasingly digitalized starting in the late 1980s. These innovations laid the basis of the sophisticated capabilities they now offer.

One of the early pioneers in the control and monitoring of CNC machine tools was Rob Caron, fresh from a local Connecticut area university with his electrical engineering degree. Now a licensed professional engineer, he designed the first CNC Tool Monitoring Adaptive Control (TMAC) system. That's the flagship product of Caron Engineering, Inc., his 30-employee company, founded in 1986 and based in Wells, Maine.

TMAC reduces the high costs associated with broken tools, lost production and rejected parts by effectively measuring tool wear in real time. Deployed at scores of aerospace manufacturers, it can consistently reduce cycle times by as much as 55 percent and prevent material loss from tool breakage.

Challenge: Provide a way to automatically update specific CNC tool usage history data for a major aerospace manufacturing customer seeking to reduce time and errors of manual data collection and entry.

"Aerospace components, especially those for engines, are made from materials that are extremely tough to machine," Caron explains. "Tooling breaks down at a much higher rate with these tougher materials, making it more difficult to determine how fast the tool can be driven without causing damage to both the tool and material. With the cost of these parts always rising, scrapping parts due to tool breakage can be very costly."

But one of the biggest challenges in managing this issue is that of identifying and tracking CNC tool dimensions, location, usage and histories. For aerospace manufacturing, CNC machine tools can have more than 200 tools, with as many as three operating simultaneously. Tracking each one's use and history manually takes a lot of time and is prone to errors. "Of course, the end goal is to avoid costly production disruptions," says Caron. "So it just makes sense to minimize that risk by reducing the amount of manual inputs and automating the process as much as possible."

Specifically, one of Caron Engineering's largest customers – a global jet engine manufacturer – needed a way to better manage the tools in its CNC machines. These are outfitted with a series of cutting tools, from 100 to 200 per machine, depending on the machine.

Each tool is preset with the required measurements and tool capability needed to properly cut components for a jet engine. The Caron TMAC adaptive control feature automatically adjusts the CNC machine tool's feed rate percentage based on the cutting load. This accounts for the wear that inevitably occurs over the life of a tool, which is why it is so critical to monitor that data.

To improve the performance of its CNC machines and operators even more, the aerospace manufacturer wanted to eliminate the manual data entry of the CNC tools that operators had been doing. Previously, each time a tool was loaded into a CNC machine, operators had to input all the tool's parameters into the system via a keyboard. Not only was this time-consuming, but operators could also make mistakes. What's more, when a tool was removed from its CNC magazine, there was no way to track its current status.

Ultimately, the company's goal was to save the time and potential errors of having to manually input tool information, while also reducing tool breakage by having greater visibility to the useful life remaining in each one. That way, tools can be replaced before failing and causing production disruptions and scrapping of nearly completed parts.

Solution: Deploy Tool Connect, an automated tool identification and tracking system using a compact Siemens high frequency RFID system to read and write tool data.

In response, Caron's engineering staff customized a solution called Tool Connect to the aerospace manufacturer's specifications. Either deployed as a TMAC companion system or as a standalone, Tool Connect is unique in being one of the industry's only add-on tool identification systems for CNC machine tools. It automates the transfer of tool presetter data to the CNC machine control using small RFID tags set in the tool holders.

To read and write to the RFID tags, Tool Connect uses a subsystem from the Siemens SIMATIC Ident family of industrial identification solutions. The subsystem's core component is the low-cost, compact SIMATIC RF250R high frequency RFID reader operating at 13.56 MHz to read and transmit tag data rapidly across short distances, to the Tool Connect system.

According to Caron, the Siemens 8 mm SIMATIC ANT8 external radio antenna enables the Tool Connect solution to span a wider range of tools, especially smaller ones. “The smallest antenna from other suppliers are 12 mm ones,” he notes. “That may seem like a minor difference, but by being 30 percent smaller, the Siemens 8 mm antenna expands the range of tools we can cover with our Tool Connect system.”

Compliant with the ISO 15693 RFID standard, the Siemens SIMATIC Ident RFID subsystem also enables Tool Connect to read and write to tags from any supplier. The aerospace customer, however, uses Siemens SIMATIC Ident MDS D421 tags. These circular-shaped tags are 10 mm in diameter and 4.5 mm thick. They are made especially for when small sizes and exact positioning are required, such as in the Tool Connect application.

The tool presetter writes data to the RFID tag embedded in the tool holder. To transfer presetter data of a specific tool, a CNC operator on the aerospace manufacturer’s shop floor puts the tool’s holder in a RFID read station, called a tool pot, at the CNC machine, which is then read by Tool Connect. Its data is displayed on an 8-inch, color Siemens Comfort Panel HMI touch screen, which provides user prompts and status information.

The HMI displays an image of a particular tool, so the CNC operator can confirm that the correct one was loaded. Its operator screens were customized for the customer to show user-defined information read from the tool’s RFID tag. For example:

- A tool’s custom assembly number for tracking
- Measurement data, such as length, weight, diameter, radius and more
- Tool life data, written to and from the RFID tag by Tool Connect

Then, depending on the type of CNC machine, the tool can automatically index to the correct magazine position. And, because the Siemens SIMATIC Ident RFID subsystem uses open communications standards, it can interoperate not only with Siemens SINUMERIK CNC controllers but also with other CNC controllers, such as Okuma, Fanuc, Heidenhain and Mitsubishi.

Results: Improved CNC tool visibility, optimized tool usage, reduced risks of production disruptions, while saving CNC operator time and eliminating data-entry errors.

Caron reports that his company’s aerospace customer and its CNC operators are extremely pleased with the Tool Connect solution that uses the Siemens SIMATIC Ident high frequency RFID subsystem.

“At this point, it’s too soon to say how much time, cost- that Tool Connect is saving our customer or to compare frequency of tool breakage,” he concedes. “But the CNC operators have welcomed the Siemens RFID capabilities, because they’re now spared the data-entry chores they used to have to do after every tool use or during a single shift that could total a half hour or more. Now they can focus more on the quality of their output, while keeping production moving and not be worried about scrapping an expensive part due to data entry errors.”

For Caron Engineering's developers and engineers, the Siemens SIMATIC Ident high frequency RFID subsystem was easy to program and configure. "Compared to our experience with just about all the other industrial RFID vendors out there, the Siemens RFID platform was by far the easiest and most straightforward to implement," Caron says. "We were able to do all we needed to do in just a day, while the others can take up to three days with twice as much effort."

Also, Caron found the small size of the SIMATIC RF250R high frequency RFID reader – about that of two packs of gum – has made it easier to fit into Tool Connect's form factor, keeping its overall dimensions compact. That's in addition to the 30-percent smaller 8 mm size of the SIMATIC ANT8 external radio antenna. "The smaller reader size makes the engineering and manufacturing of Tool Connect easier, while the smaller antenna not only helps Tool Connect cover more tools, it also effectively expands our markets," Caron says.

Finally, having Siemens global service and support helps Caron Engineering sell Tool Connect around the world. That's because, like its aerospace Tool Connect customer, many prospects in aerospace and automotive industries are global. "Although the Siemens SIMATIC Ident RFID systems are solid-state and highly reliable, it reassures our customers that no matter where in the world they deploy Tool Connect, its core RFID subsystem is supported by the global market presence of Siemens."

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