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Innovative software and powerful controllers propel fin press manufacturer into new markets

Building standard machines to custom specification

Siemens Industry's TIA Portal engineering software and S71500 series PLCs are helping a Michigan OEM build new equipment faster, better, and more economically and enabling it to expand its business at home and abroad.

Every manufacturer knows that to survive in today's global environment, it must use cutting-edge technology and operate at peak efficiency. Burr Oak Tool Inc., a designer of custom production machinery for the world's heating, refrigeration, and air conditioning industries, is no exception. So when the Sturgis, Michigan-based OEM made plans to develop a new cost-effective product it hoped would open the door to overseas markets, it knew it would have to make some changes to its usual way of doing things.

The company is known for rugged, high-quality products that provide consistent, dependable results. For more than 65 years, it has installed heat transfer and tube processing equipment in more than 70 countries. "At this point," says Eric Lund, controls and software engineering manager at Burr Oak, "we wanted to build a high-quality fin press for the HVAC industry at a more economical price to target new customers in overseas markets, such as Asia."

To give the company the state-of-the-art tools and capabilities it needed for the job, the OEM turned to Siemens Industry for help, and found just what it needed in the automation leader's new line of innovative S7-1500 PLCs and its established engineering software, TIA Portal. The company was already familiar with Siemens technology, its reputation and global presence. "We've worked with Siemens more than 10 years," explains Lund. "Then, coincidentally, we were in the midst of developing our new machine, the FP 400, and Siemens approached us about the new PLC and the latest version (V12) of TIA Portal. The preliminary performance and pricing value on the PLC was especially attractive, as was its integration with TIA Portal. They seemed like a perfect fit for the new press with their outstanding processor performance and a price that would help us achieve our goal of producing a lower-cost machine."

Managing all tasks in one environment
The company found significant advantages in the hardware and the software to benefit its new launch. On the software side, Burr Oak was already using an earlier version of TIA Portal, groundbreaking integrated automation software that combines PLC, PC-based control, HMI, and network configuration in a single engineering environment. The company was familiar with some aspects of TIA Portal, and as the staff probed more deeply into its capabilities, it found a number of features especially valuable to the development of the new fin press. Among the most noteworthy were:

Trace functions. Trace for real-time diagnostics is essentially a dynamic graphical editor that illustrates changing variables. "It's like having an oscilloscope so I can see the values of analog signals, maybe the position or voltage of a motor," says Lund. "At the same time, I can overlay that with the state change of binary values and improve our timing, which is very important to us."

Using the trace feature, Burr Oak engineers can put the logic they have written through its paces and verify it is performing as expected. "The FP 400 fin press contains an encoder that shows the position of the ram on the press," adds Adam Broadwater, Burr Oak research and design engineer. "When we trace that encoder position with the machine running, we can pull in binary types of operations (switches, valves) while the press is rotating and verify the operations are turning on and off during the rotation of the press properly."

Further, the company uses an expensive progressive die in its machines. "It is critical to protect these valuable dies as the tooling shifts in and out," notes Lund, stressing again that timing is critical. "Shifting the tooling at the wrong spot could ruin it. Having data that shows the position of the ram and when the tooling is coming in and out lets us ensure we are operating in a safe position. TIA Portal, and the tracing feature in particular, is a powerful validation tool that helps us do this. It validates the software we've written is functioning as expected and helps protect the die by adjusting the timing precisely."

High-level programming
The company also found TIA Portal's high-level programming languages a great benefit. The engineering software includes five IEC programming languages: ladder logic, function block diagram, statement list, a graphic programming editor for sequential steps, and SCL (structured control language), a high-level scripting language editor. "The new SCL editor in version 12 of TIA Portal is fantastic," admits Broadwater. "It has so many different features. It makes it very fast to write software – to condense blocks so you can shrink your code and see what is going on, to be able to automatically populate variable names, to create a library for a function and then use it in a different project elsewhere. All these things have been very useful to us."

Cross-reference features. TIA Portal's cross-reference feature dispels any temptation to look for any other code editor, notes Lund. Cross referencing, which enables common handling across all the IEC programming languages, lets the user browse for tags in all blocks of the PLC and, importantly, in any of the HMIs connected to a PLC that reference that tag. "The cross-reference feature is awesome," adds Broadwater. It is tightly integrated and a true time saver."

Project organization. The file tree in TIA Portal lets the Burr Oak staff keep all project elements organized. "It has features I wasn't accustomed to," says Broadwater, "but after I started taking advantage of them, I grew to like them very much. Multiple pieces of equipment are being controlled within the PLC. With the file tree, I can sort my function blocks and data blocks into a logical folder structure. That was not available in other editors. This allows me to condense my project so that when I'm working on something inside the project, I don't have to have all the other function blocks showing in the project tree."
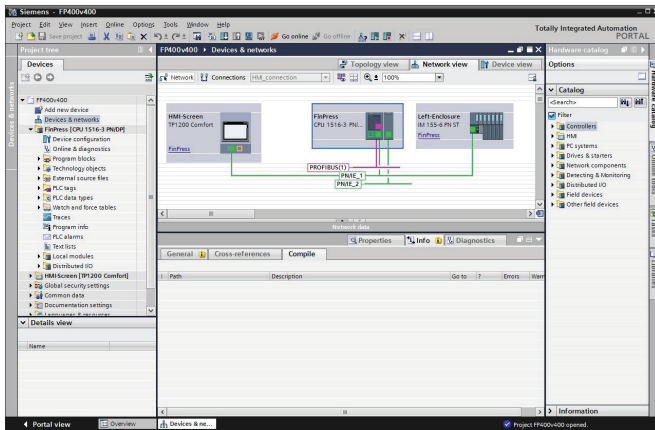
Similar capabilities are available for the PLC HMI screens. "Recently, I created subfolders for the different elements inside the HMI," continues Broadwater. "Inside a die data option screen are three sub-screens. I made a simple folder and put all those screens inside, so when I need to make a change in one HMI screen, I don't have to open a huge file tree of 50 or 60 HMI screens. I can drill down quickly into the file folder structure and get to the screen I want much faster."

A creative application – with unexpected benefits
On the hardware side, Burr Oak found a lot to like in Siemens S7-1500 Series, from improved I/O modules and wiring techniques to the diagnostic display on the front of the unit. The innovative controller maximizes productivity for machines and installations that place high demands on speed and deterministic. And, of course, its seamless integration with TIA Portal adds efficiency and usability.

"The display was apparently intended for diagnosing wiring faults, says Lund, "but we discovered an unexpected application. We've been striving to write software with a core code applicable to each machine so that we are not constantly writing unique code. A core code runs the base machine, but each customized unit has different in-feed and out-feed options. So we created function blocks to operate each type of mechanism with some commonality amongst them. We can mix and match the options with the core code and not have to constantly debug and reproof all the code as we customize the units."

When a new machine is commissioned, the code already has been debugged. A technician needs only install the programmed memory card, startup the controls, enable/disable the in-feed and out-feed options, and debug the machine itself. "For years, the software engineer loaded the software on memory cards and passed the machine to a technician for start-up," explains Broadwater. "The technician then sets the options. Invariably, at this point an error would occur in the PLC program. Typically, the problem was a wiring or plumbing mistake, not an error in the software. Nonetheless, a software engineer would need to unplug from his desk, re-set-up on the shop floor, connect to the

machine, and help find the error. Now, with the display screen and diagnostics capabilities of the S7 1500 PLC, the technician can use the interface to go into the PLC and see what errors are there. By referring to the machine schematics, he can determine what is wrong without involving the software engineer."

Such creative use of the display has made commissioning faster and simpler. Full diagnostic information is available and no PC is needed. With simple training, Burr Oak technicians now can solve most problems and complete the commissioning themselves while the software engineers remain at their desks, using their skills and time more efficiently.

"Of course, we also use the display as Siemens intended it," adds Lund. "Last week, as I was showing visitors through the shop, an electrician stopped me because one of the new FP 400 units was not working and he didn't know why. I didn't have my laptop with me, but using the PLC interface I diagnosed the problem – a network error between the PLC and an HMI – and got the equipment up and running again."

Another attractive advantage of the new hardware is its use of minimum inventory. The S7-1500 uses a standard terminal module across all I/O modules. "Our stockroom no longer needs to have one terminal module for the encoder card and another for the 32-point output card and yet another for the 16-point input card," notes Broadwater. The same one works for all applications. It is a standardized piece."

Finally, Burr Oak is pleased with the simple wiring procedures of the I/O modules. With the wiring location on the front of the unit, a technician can simply pull the terminal module out of the I/O position so it is not physically connected to the PLC. "The terminals are exposed and visible," says Broadwater, "so it is easy for the electrician to wire, yet everything remains properly positioned so that the length of wire is correct when the job is complete. Further, everything is neat and clean. A spring-loaded latch pops the terminal out and brings it to a resting position and then brings it back and locks it in. It is efficient...and creates a nice looking panel."

A winning combination, a dynamic future

Lund and Broadwater agree the Siemens products have brought significant benefits to Burr Oak operations. "Together they have reduced engineering time some 30%," says Broadwater. "We weren't holding a stop watch to our activities, but everything moves faster with TIA Portal. And commissioning the machines in the I/O modules is saving a lot of time as well. We make and ship between 20 and 50 fin presses annually. In the past, it took at least two hours of a software engineer's time per machine to debug the errors. Those hours are saved because the technicians can debug the units themselves now."

Lund concurs. "This has been a very positive experience for us," he says. "The PLC expedites debugging. The display drastically cuts the time software engineers spend on the floor doing routine tasks. At a recent sales summit, we told our reps about the new [FP 400] machine and one of them was so happy with what we'd done with its design and layout he said it appeared we had made the machine specifically for his customer base in India."

It looks like that goal of expanding market share is well on its way to happening.

Learn more about Burr Oak Tool Inc. by visiting the company website at www.burroak.com. For more about Siemens Industry's TIA Portal, go to www.industry.siemens.com/ topics/global/en/tia-portal/Pages/default.aspx; more on Siemens Industry's S7 1500 series PLCs may be found at www.automation.siemens.com/mcms/programmable-logic-controller/en/simatic-s7-controller/s7-1500/Pages/default.aspx