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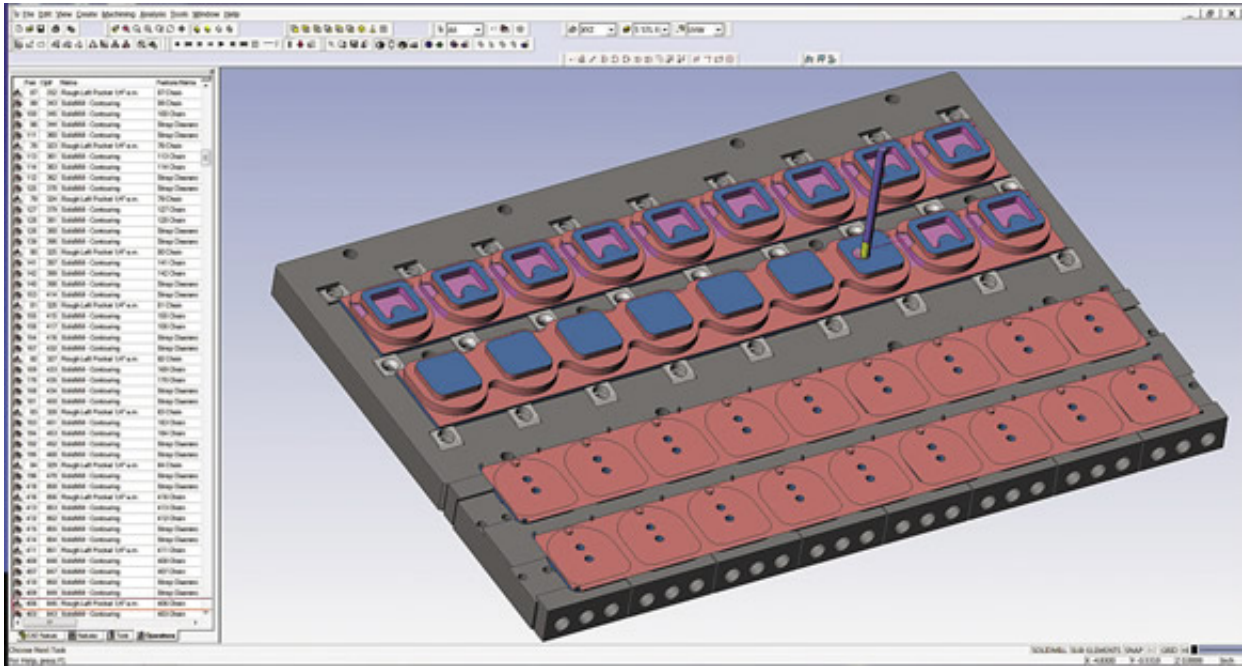
Software increases spindle utilization

By CTE Staff

Competing in today's stormy economic climate requires maximizing spindle run times because value isn't being added to a workpiece if chips aren't raining down. Mark Ames, owner of Mainland Machine, sought to dramatically increase the San Luis Obispo, Calif.-located job shop's spindle run times and accomplished it with a CAM program capable of maximizing the benefits of several machining strategies being implemented at the shop.

Founded in 1983 by Ames, Mainland has machined parts for photography gear, microwave communications, the medical and aerospace industries, motorcycles and motion control equipment. In addition to machining, the shop offers assembly, laser engraving and product design services. "At Mainland, we do not just make parts to a print, we get an understanding of what the part is doing," Ames said. "Just because a part is made to print does not mean it is going to perform the function the customer needs it to; parts aren't always 'toleranced' correctly."

Mainland was able to support its customers' needs with tried-and-true methods such as machining several parts one side at a time in multiple vises on its 17 Fadal 3-axis vertical machining centers. However, this method limits spindle run time to about 33 percent efficiency because tools are in the cut for a relatively short period of time—from seconds to a few minutes. This requires the spindle to stop frequently for tool changes, which consume about 20 seconds on a Fadal VMC.

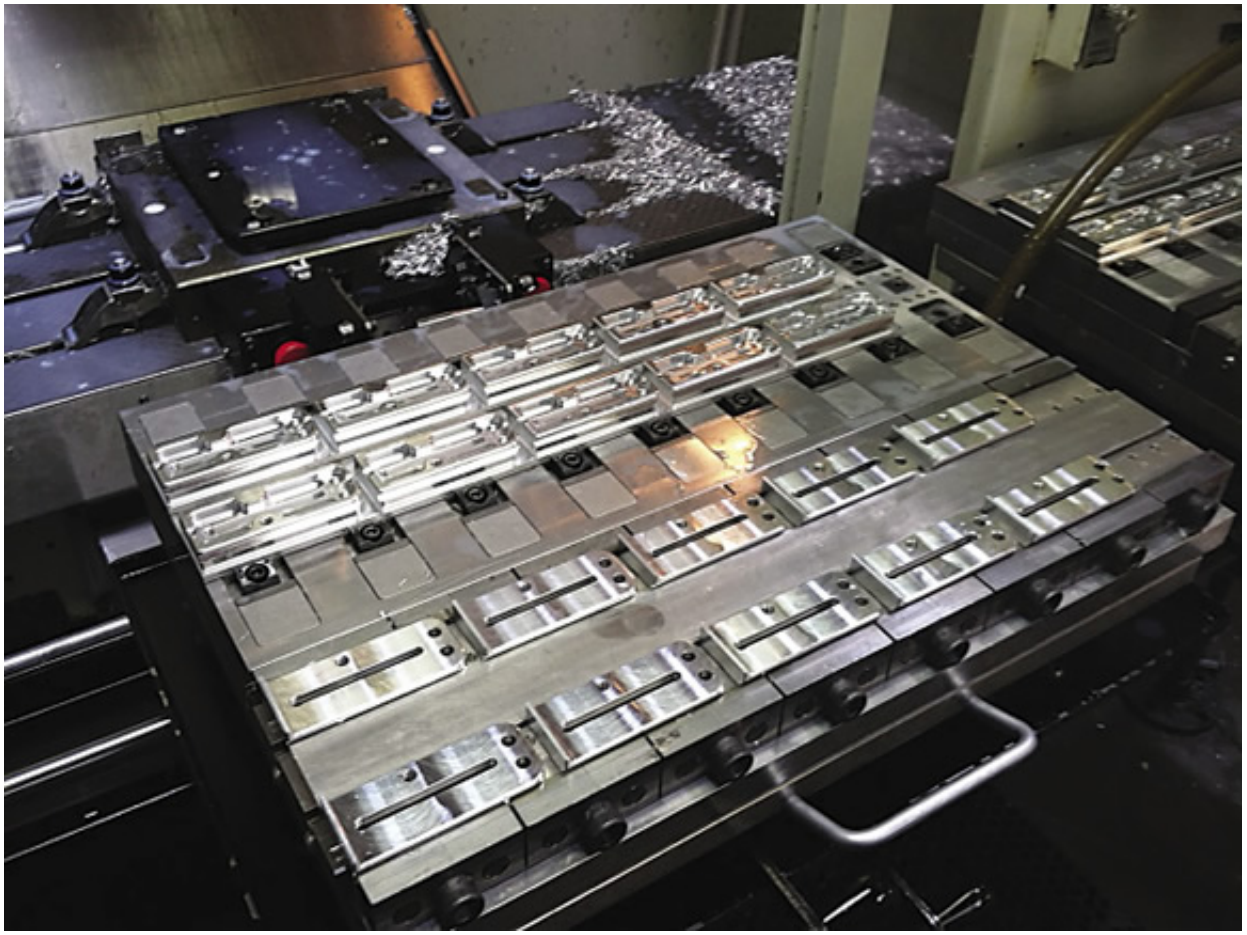


ESPRIT software performs a simulation of Mainland Machine's pallet system with two setups. Image courtesy DP Technology.

That time means little when the tool is in the cut for an hour but is significant when, say, applying 25 tools to cut a group of parts with a 15-minute cycle time, Ames noted.

To increase spindle run time, Ames upgraded some of its VMCs with Midaco pallet changers, which enable a machine to run one pallet while an operator unloads and loads the next one. To maximize the potential of the pallet changers, Mainland also designs and builds fixture plates that hold workpieces and allow multiple machining operations on multiple parts. For example, a part that requires two operations could be machined in a fixture holding four rows of 10. The first two rows could be operation No. 1 while the next two could be operation No. 2. Therefore, each time the operator changes out, 20 parts will be completed.

However, Mainland discovered that its CAM software was only capable of generating code that would machine multiple parts of the same operation or generating code that would machine all of the first operation, then the entire second operation and so on. The latter requires many redundant tool changes. "Most CAM software programs are designed to program one operation at a time," Ames said. "They're not set up for programming a part complete all at one time."



Mainland Machine uses a Midaco pallet system with a custom fixture plate, designed and built in-house, and ESPRIT software to streamline manufacturing. Image courtesy DP Technology.

After evaluating several CAM systems, Ames determined ESPRIT CAM software from DP Technology Corp., Camarillo, Calif., could effectively take advantage of the upgrades Mainland had implemented. In addition to the pallet changers and fixture plates, those upgrades included adding two DMG/Mori Seiki 4-axis NH5000DCG horizontal machining centers with 240-tool magazines and four Okuma lathes, three with a subspindle and live tooling for performing mill/turn operations, to reduce setup and load time on complex parts.

The most important upgrade was the new fixture plate system, according to Ames. The software's ability to create multiple fixture offsets and then organize the toolpath so each tool cuts all that it can before the next tool is applied made the choice clear, he noted. "With ESPRIT, you can use the cutting tool you

were using in the first operation for the second and third operations if needed without doing a tool change," Ames said.

The tool change on the horizontals is 2.8 to 15.8 seconds. The time varies because a machine has to put away the tool it just exchanged during the tool change and go get the next one, Ames explained. "To have chip-to-chip tool change times of 2.8 seconds, you need to have at least 13 seconds of machining before doing another tool change," he said. "Thirteen seconds may not sound like much, but operations like center drilling and drilling may not take 13 seconds if you are not running enough parts at a time."

There are advantages and disadvantages to running parts in fixture plates, according to Ames.

The advantages include:

- A user can run more parts and operations at one time, which minimizes the cost of the tool changes.
- Fixture plates are a more rigid setup, which enables longer tool life and finer surface finishes.
- Setup times are quicker.
- The machine runs for longer periods of time, allowing an operator time to perform other functions.

The disadvantages include:

- Fixtures are time-consuming to design and build.
- If the part gets a revision, the fixture may need to be remade.
- The order quantity must be large enough or the job must repeat often to justify the expense of building the fixture.
- It takes much more time to dry run the program and fine-tune the fixture offsets for all of the parts on the fixture plate than running parts in vises. This only applies the first time the job is set up.
- It takes more time to program a pallet of parts than one part at a time.

"When a job justifies the investment in creating a fixture plate, the advantages far outweigh the disadvantages," Ames said.

ESPRIT uses a different approach to programming multiple parts than what is commonly used, he noted. The majority of CAM systems generate the code for multiple parts at the time of posting. With those systems, a single part is programmed and a series of questions are asked during the posting process. Then the software generates the code to machine the number of parts the user instructed the software during the posting process.

Ames said: "The problem with this approach is you are just duplicating the way you programmed a

single view of a single part. When you program a fixture of parts that have multiple views of the part being machined at the same time, answering questions at the time of posting no longer works; it doesn't allow for fixture offsets of different views and it doesn't allow you to jump around from part to part in any order you decide is necessary to program the fixture of parts in the most efficient way. ESPRIT does not have these limitations because all of the programming for all of the parts is completed before the posting process. There are no questions asked during the posting.

"And when you verify the part, you can see all of the machining that is going to take place, so you can see if you are accidently bumping into the part next to the one you are working on or if you are bumping into the fixture," he continued. "You verify the entire program—not just one part—so there are no surprises on the shop floor. You cannot get this kind of verification when a single part is programmed and then copied during the posting process. Time and time again I write programs that require no editing on the shop floor."