Stand and Deliver – Profits

Breaking bottlenecks is what it's all about for this fabricating shop. Proper throughput keeps the work and dollars flowing.

Components to be welded are mounted to the Bluco beam using angles, blocks, and other elements. The two beams then rotate, providing the robot welder with access to the surfaces, allowing all of the welds for two assemblies in one operation.

Superior Fabrication, Kincheloe, MI, bought into the Theory of Constraints – TOC – in 2001. The premise of TOC is that revenue is constrained by one or more bottlenecks. By increasing the outturn at the bottleneck, system throughput increases and revenue grows.

At Superior Fabrication, TOC mandates that once a product is started, it is completed without interruption. Partial products – which can't be shipped and billed but which have to be stored, tracked, and handled at extra effort and cost – must be avoided.

"When we schedule a small batch of components, the goal is to completely fabricate it – from raw stock to finish paint – in a single, continuous process generally requiring no more than a week or two," Don Plumm, manufacturing manager, said. "The idea is everyday raw material comes in the door, and everyday a truckload of finished product goes out."

Expediting the Day's Run

Each day, the facility outputs that day's product requirements for sawing, burning, machining, stamping, bending, fixturing, tacking, finish welding, assembly and painting. When a station finishes its allotted tasks, cross-trained operators shift to where they are needed to expedite the day's run.

Founded in 1979 primarily as a supplier to the defense industry, Superior Fabrication manufactures military armor components, but has expanded to become a provider of rough terrain forklift masts and carriages to OEMs such as Case, JCB, Ingersoll Rand, Princeton Delivery Systems, and others. The company enjoys a significant aftermarket business in its material-handling lines. It also manufactures a medical specialty tool – an orthoscopic vise.

TOC analysis at Superior Fabrication identified problems with the company's workflow. The company determined material moved through the shop in batches that were too large – raw material was cut to size in quantities sufficient for an entire month of operation rather than for the short production run. The last manufacturing operations, such as painting and other final processes, became overloaded at the end of the month, while beginning and intermediate stations were under-active. Constrained by bottlenecks, production stuttered. Quality assurance was difficult, while shipments and billings were irregular.

Finding a Solution

Identifying the problem was the first step, finding a solution was the second.

TOC puts a premium on setup speed. Superior saw an opportunity to accelerate the production process in welding fixturing.

"Many of our runs aren't long enough to afford dedicated welding fixturing," Plum said. "Open fixturing – a fairly crude affair involving framing squares, chalk, piano wire, and tape measures – may be okay for setting up just one piece. But, we pay a price in terms of fit-up adjustments at the assembly stage. We knew there had to be a better way."

Plumm said his company was quoting a new mast-scissors component for Princeton Delivery Systems and estimates for permanent welding fixturing seemed out of line.

"After some research, we found Demmeler Modular Welding Fixturing Systems from Bluco Corp." he said.

Superior Fabrication decided to make a capital investment in a Bluco fixturing system and amortize its cost, instead of including it as a permanent fixturing in the Princeton price quote.

"In the pre-production meeting with Princeton, they asked how we were going to tool their product," Plumm said. "I presented a tooling layout prepared by Scott Ellig, vice president at Bluco, and it knocked them out."

Plumm said Princeton understood his company would not include the full cost of the Bluco fixturing system in the Superior Fabrication quote. The system would belong to Superior Fabrication.

Winning Idea

"The economics of the reusable components approach, along with the quality of the fixturing layout, won them over," he said.

The Demmeler system from Bluco Corp., Naperville, IL, is based on a five-sided, high tensile-strength steel table with a grid of accurately-located 1.1" bores on 3.9" centers, a pattern of grid lines across the top, and a scale etched on all four edges to aid setups.

Table flatness is 0.004" overall and the bores are located ±0.001" hole-to-hole and ±0.002" overall. System angles and blocks can attach to the table's sides as outriggers for parts that are larger than the table surface.

Fixture elements are engineered to precision-match the table's hole-and-grid pattern for quick setup, stable performance, and easy removal.

Structural pieces have slots to locate fixtures between holes. Positioning and clamping bolts attach fixtures, workpiece positioners, and other elements to the worktables or to each other. The hardened clamping bolts provide up to three tons of clamping force and withstand up to 25 tons of shear.

"We'll setup on Bluco tables if we have a run of two or more assemblies to weld at one time," Plumm said. "Setting up a Bluco to run two pieces incurs a slight increase in the amount of setup time compared to open setups; however, we achieve a large gain in the quality of the finished weldment.

"This increased quality saves us time at assembly since it virtually eliminates rework. When we run a batch of three or more weldments, we have experienced a 20 percent increase in efficiency."

Prototyping Ideal

"Another way that the modular Bluco tables impacted efficiency is that they are ideal for prototyping," Plumm said. "The tables act as their own built-in metrology and inspection gage. Because of the regular bore pattern around the top and the sides of the table, once the process is established and has made a good part, part geometry can be extracted and used to document the fixture and the process."

Superior's Bluco modular fixturing has also been used in fabrication of a pivot assembly detail for a telescoping arm of an Ingersoll Rand handler. The finished part is roughly 4"×8"×48" and made of 3/8"-wall rectangular tubing and A-36 mild bar stock. The piece is large and complex, requiring precise joining of numerous sawed pieces.

To fabricate the part, Superior created an automated cell. The configuration incorporates two 8"×8"×10' Bluco modular beams around a Superior Genesis Versa 2 robotic MIG welding cell on either side of the robot's arm. The 10' Bluco beams are mounted at their ends to servo-positioners for automatic rotation about their long axes.

Welding components are mounted to the beams with standard accessories, such as angles, blocks and other elements. The two beams then rotate, providing the robot's welder with access to all surfaces – enabling completion of all welds for two assemblies in one operation.

This approach levels workloads across various shop functions, reduces total labor hours incorporated into a component, and improves quality, according to Plumm.

The fixturing positions accurately achieves consistent weld profiles, excellent appearance, and faster weld rates.

This configuration has proven so effective that Genesis Systems Group has duplicated the setup for other robotic applications.

Superior employs 75 people in its 125,000 ft^2 facility. For vehicle-related products, the company mainly fabricates construction- and HSLA-grade steels, with stainless as the primary medical products material.

Superior's typical deliverable is a fully finished, ready-to-install component. Most mast designs are Superior's own while others are the result of the company's engineering collaboration with OEMs. At times, Superior simply works from supplied prints. Some mast designs have been in production for 20 years, others are new. When innovating new designs, Superior does extensive prototyping and testing. *Bluco Corp.*

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