

# the fabricator<sup>®</sup>



A portion of a QRM cell at Dowding shows how parts flow from the lasers (in the background) through forming and spot welding. Robotic welding, which is out of frame, is also part of this cell.

a hand-fed stamping press, on to another brake, and then to a robotic welder, after which the welding operator removed the welded part, packed it in a shipping bin, and sent it to the loading dock.

The cell proved to be a good testing ground, considering it processed a limited variety of parts (just six part numbers) and, for these products at least, carried the work all the way from the unbent blank to the shipping dock. It exemplified just how quickly the shop could respond to the customer's weekly order for parts. But in the beginning, employees in the cell seemed a little unsure.

## ***Keep work on the move***

One shop's holistic approach to flow, from quoting to shipping

By Tim Heston

For a few employees at Dowding Industries, the change hadn't sunk in yet. Early last year the Eaton Rapids, Mich.-based custom metal manufacturer instituted its first quick-response manufacturing (QRM) cell. Fed by laser cutting machines, the QRM cell processed a variety of part families through multiple manufacturing steps. Parts went from one press brake to



Employees in the quoting and development Q-ROC (quick-response office cell) collaborate continually to streamline quoting and product launches.

As Eric Aten, vice president of operations, recalled, “Many kept asking us, over and over, ‘What are we supposed to do next?’ And we kept saying, ‘You have your marching orders [the weekly order from the customer]. It’s your responsibility to get these from point A to point B.’ It took a little time, but when they caught on, the light bulbs went off. They began to take ownership.”

That idea of ownership lies at the heart of QRM, an improvement methodology developed by Rajan Suri out of the University of Wisconsin-Madison. The ownership isn’t over a specific task, like bending or welding, though task mastery is obviously needed. Instead, people take ownership of a job. That is, a team works together to ensure a job gets through multiple manufacturing steps and, ultimately, to the customer’s receiving dock.

Dowding had experimented with cellular manufacturing for several years before formally adopting the QRM method, but over the past two years the company has expanded its adoption. It has developed QRM cells in fabrication and especially in its office operations, including quoting, job launch, and process development.

The 200-employee, \$30 million fabricator is in the middle of a growth spurt, with sales jumping 30 percent each year over the past two years. And according to sources, the company is handling the increased work load just fine, with time for extra improvement projects to spare. And the jobs keep moving, without spending hours, days, or weeks sitting between operations. When jobs keep moving, it’s amazing what can be accomplished.



This first cell at Dowding Industries, developed before the company formally adopted QRM, grouped together laser cutting, hand-fed stamping (for stamping numbers into parts), and press brake bending.

## The White Space Between

Any manufacturing improvement ideally should aim to shorten the time it takes for a quote to become an order and an order to become a delivered product. Shorten that order-to-ship cycle, and a fabricator increases sellable capacity. Shorten that cycle using existing resources, and a fabricator increases profitability or market share, or even both.

A laser cutting blanks blazingly fast is great, but if it’s just feeding a downstream bottleneck, the order-to-ship cycle doesn’t get shorter. In fact, it can actually get longer by increasing work-in-process (WIP). The more active WIP a shop has, the longer its lead time.

Map the time it takes for a part to go from one process to the next, and you’d probably find that a part spends most of its time sitting as WIP, between cutting and bending, bending and hardware insertion, weld prep and welding. Lean manufacturing calls this non-value-added time. QRM calls this *white-space time* and the actual processing time

*gray-space time*. For any product, white-space time is sure to dominate, and QRM aims to minimize it.

It does this by grouping processes together and breaking down departmental silos. Why do quotes or new product launches take forever? Blame the handoffs. A material question sits in the purchasing manager’s email inbox for hours or days. A tooling question goes unanswered. Why does it take forever for a workpiece to make it through the forming department? Probably because the laser floods the press brakes with work it can’t handle.

In a nutshell, QRM aims to minimize the inefficient handoffs and maintain flow. A manufacturer does this by identifying and measuring that “overall” manufacturing time for a job; QRM calls this the manufacturing critical-path time, or MCT—a metric that looks at the entire manufacturing cycle, from raw material to the shipping dock.

A manufacturer also segments its product mix into what QRM calls Focus Target Market Segments, or FTMSs. These can be focused on





Since Dowding Industries implemented QRM last year, employees take ownership and help manage how work flows through individual QRM cells, both in the office and the shop floor.

certain customers, markets with similar demand cycles, part geometries, material thicknesses, or a combination of these and other variables.

Regardless of how they're defined, the FTMSs form the foundation for QRM cells, which combine multiple manufacturing steps and give employees in that cell ownership as to how to get the work done most efficiently. For instance, in Dowding's initial QRM cell, employees received a weekly order, and it was their job to manage it.

"When they had that ownership, they began experimenting and coming up with all sorts of improvements on their own," Aten said.

He added that this happened thanks in part to cross-training. A press brake operator can fixture a part and run the robotic welding cell, and the welding robot operator can call up a program and bend the needed product on the press brakes. These cross-trained individuals aren't setting up complicated staged bending programs, of course. Because this cell has a limited range of products, the bending programs don't vary significantly.

More important than this was employing those willing to learn. "Because we had to cross-train people to perform multiple jobs, there was some pushback, but



we incentivized them so they would want to cross-train, and we showed them the personal benefits," said Mike Gonser, executive vice president. "This was a culture piece of the QRM experience that I think Dowding did right. We spent a lot of time explaining, training, teaching, and communicating with our employees."

What are those personal benefits, exactly? Employees become more valuable to the company, of course, but as sources explained, they also gain the satisfaction of bringing a project to fruition.

## No Stranger to Cells

The QRM cell wasn't Dowding's first foray into cellular manufacturing. The manufacturer has diverse capabilities, including a separate machining cell that can mill some seriously large workpieces; a bridge mill in that plant sits on a 96-foot-long rail.

The company has another plant dedicated to stamp-

ing, along with its plant dedicated to metal fabrication. It has a range of customers, including some well-known construction equipment OEMs. One of them worked regularly with Dowding to spread some of the principles of lean manufacturing. Being a high-product-mix manufacturer, Dowding found success with some elements of lean, but not others. For instance, it had limited success with value stream mapping.

“Any one of our part numbers could go to any number of machines and any number of routings,” said Dave Barrett, training manager. “We’re talking about thousands of parts, and we really never got anywhere. We were trying to eat the whole elephant in one bite.”

The company did, however, find success launching its first manufacturing cell. Several years before they knew anything about QRM, managers analyzed their product mix and chose a range of part numbers that shared similar routings. In 2013 they took their first stab at putting together a cutting and bending production cell, with a laser adjacent to a hand-fed stamping press (for stamping part numbers) next to a press brake. They cross-trained individuals so that they could shepherd the work through multiple manufacturing steps as needed.

“We ran more than 550 part numbers in that cell,” Aten recalled, “and that was before we were familiar with QRM.”

Several years later Dowding’s CEO, Chris Metts, received an email from the QRM Center at the University of Wisconsin-Madison, publicizing a class dedicated to cellular manufacturing. She then had several managers attend classes at the QRM Center to learn the methodology, which

happened to be tailored for low-volume, high-mix operations like theirs.

## The Office Cell

The QRM cell in the fabrication shop, launched in 2017, dedicates bending and welding resources to a specific product family, but not laser cutting. The company’s five laser cutting machines instead feed the cell and the rest of the shop, which remains in a departmental layout.

Sources said that this makes sense considering the immense capacity of laser cutting. Having a laser cutting center sit idle in a QRM cell, as constraints are cleared in bending or welding, just wouldn’t make business sense.

All the same, the QRM cell gave managers a kind of prototype, proving the concept would work at least for some products in Dowding’s product mix. That said, learning what they did about QRM, managers knew that every process in the business, from quoting to shipping, was ripe for improvement. And why improve throughput, and in doing so increase available fabrication capacity, if those in the office can’t sell, quote, and launch product programs to use that increased capacity?

With this in mind, managers launched a cellular initiative for the quoting and product launch team. It was classic batching inefficiency, with each person performing just one or a handful of tasks on a launch, working through deep inbox piles and scrolling through dozens of unopened emails. One person evaluated the drawing, another tackled the tooling, yet another handled the contract and material needs. The process engineer would design the blanks and build out the process steps. An estimator would then pull

all that information together and hand it all to a manager for review.

When people worked in “silos” departments, it took estimators and engineers about five days to turn around a quote of average complexity. But after mapping out the process, managers found that throughout those five days, only about three hours were spent actually processing the individual quotes.

Still, only three people worked in quoting, and yet managers found that many of their duties were duplicated in the launch team, which carried an accepted quote through advanced product quality planning and set up the paperwork within the enterprise resource planning and quality systems. They in turn worked with the development team in the prototyping department to create the tools, fixtures, and first articles.

Because the quoting and launch team shared much of the same expertise anyway, why not combine them into one? This way, if quoting gets overloaded, people from the launch team can assist, and vice versa. Now, instead of “throwing work over the wall” into other people’s inboxes, the cross-trained team carries a job through quoting and (if the work is won) product launch.

“We’re about a year into a project with our quoting and launch team,” Barrett explained. “They used to be in many different silos, so we put them together in a Q-ROC team.” That’s QRM lingo for a quick-response office cell.

The team works on product launches for the entire enterprise. “We debated that for months,” Aten recalled. “We thought about breaking up the team so they could focus on specific FTMSs,” but in the end decided to keep the team’s broader focus.



They instead mapped out the quoting and launch process in different “swim lanes,” each lane showing where a different function had to take over to keep the launch process swimming along. They then instituted a cross-training regimen to minimize the handoffs, which of course is the source of the most significant delays. Again, a job’s white-space time on the floor is spent sitting as WIP; in the office, the job’s white-space time is spent in inboxes—both real and digital.

“The quoting and launch team now handles every step,” Aten said, “though not everyone works on every project. All eight might work on one large project, just three may work on another smaller project, and so on. And we don’t separate lanes within the cell.” That is, even if a person has years of experience in CAD or tooling development or another specialized process, that person isn’t instructed to spend a certain amount of time on those tasks. It’s all left up to the team members, who work together to respond best to customer demand.

“Our average lead time on a launch [in metal fabrication] is now 17 days,” Aten said. “That’s down from 60 to 90 days.”

### **Pick a Card, but Not Just Any Card**

A team may be able to manage work within and between cells informally, but for optimal efficiency, it really needs a quick way to communicate, to know immediately what to work on next.

In low-product-mix situations, simple *kanban* replenishment can work wonders for efficient, intuitive communication. Those who work at a particular department or cell know not to produce un-

less they see an empty *kanban* cart (such as a bin or taped-off area, or whatever else) ready to be replenished. They produce based on real demand that’s “pulled” from downstream operations, not “pushed” from a dispatch list or master schedule. If the *kanban* cart doesn’t appear for a certain period (and perhaps if they see other visual cues), employees know they need to go downstream and help clear the bottleneck.

But *kanban* is based on products; so what if a cell is producing dozens, hundreds, or even thousands of part numbers? This is where another element of QRM comes into play, and it’s a tool that Dowding recently implemented: paired-cell overlapping loop of cards (POLCA).

Oversimplified, the concept essentially serves the same purpose as a *kanban* replenishment system. Only this time, instead of signaling the need for more products, POLCA signals the availability of capacity downstream.

The idea is to avoid starting work on a job unless the next cell has the capacity to take on the work. Why? Because the capacity of the upstream cell would be better used to work on a job destined for a different cell that does have open capacity and could use the work.

Say you have a job routing that goes from cell A to B to C. Card “A/B” is the “capacity is available” signal used by cells A and B, and card B/C is the capacity signal sent between cells B and C. Once cell B finishes the job it has, it can send the A/B card back to cell A, and cell A can start. The same applies to the B/C card sent between cells B and C. In general, there are multiple cards assigned between pairs of cells, since a cell typically has mul-

multiple machines and can have several jobs in process at one time.

There’s a lot more to this, including authorization lists that show operators what to work on next. Entire books have been written on the subject. In fact, the QRM Center’s Rajan Suri published a new one this year, called *The Practitioner’s Guide to POLCA* (available at [www.amazon.com](http://www.amazon.com)).

Regardless, the method has provided Dowding with an efficient way to communicate available capacity. And in recent months, the concept has helped increase flow in quoting, product launching, and process development.

“The people in our quoting team do all the design work, all the drawing, the paperwork. The team does every new product launch that we have,” Aten said. “But that team can overload our development department.”

Previously, the development department—a prototyping area that employs some of the company’s most skilled fabricators—would work through a massive stack of jobs. It wasn’t unusual for the team to be working on several dozen projects at once.

Today is different, mainly because POLCA is helping to communicate available capacity. When those in the development department send a POLCA card to the quoting and launch team, they’re signaling that they can accept more work—and they now work on only three projects at a time, instead of having to deal with the “traffic jam” of 25 projects at once.

Sources emphasized that giving the development team only three projects at a time does not typically use the development department to its maximum capacity—and that’s

a good thing. They want capacity available to handle that demand variability, like an especially challenging project.

“And we also want them to break down barriers and find improvement,” Barrett said. Improvements in the prototyping area, of course, ripple through fabrication production.

To break down departmental barriers, people in development are being cross-trained to help with product launches, and vice versa. “That’s the beauty of this concept,” Aten said. “Two or three members of the launch team will help those in the development team get through a large project. Likewise, one of our development engineers, our bend-

ing expert, is learning more about design and helping us work through some quoting bottlenecks.”

Aten added that the bending expert on the development team likely will remain the company’s bending guru. His years of press brake experience make him incredibly valuable. But even the most highly technical specialist can be cross-trained to help keep the work flowing.

### Poised for Growth

Today Dowding has extended the POLCA concept to its QRM cell in fabrication, and it’s looking to spread QRM concepts to other areas of the company. Indeed, with front-end offices streamlined, the

time is ripe to increase available capacity throughout the rest of the organization. “To give you an idea, all through 2017 we quoted 1,200 part numbers,” Aten said. “Just last month, we quoted 500 part numbers.”

When you ax the white-space time and keep things flowing, it’s amazing what you can accomplish. **FAB**

► Senior Editor Tim Heston can be reached at [timh@thefabricator.com](mailto:timh@thefabricator.com).

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## Center for Quick Response Manufacturing (QRM)

Established in 1993, the Center for Quick Response Manufacturing at the University of Wisconsin-Madison is a partnership between industry, faculty and students, dedicated to the development and implementation of lead time reduction principles.

For almost three decades, the QRM Center has helped more than 300 companies of varying sizes from a wide array of industries reduce lead times in all aspects of their operations to become more competitive in the global marketplace. The Center can point to a remarkable track record, with several member companies realizing lead time reductions exceeding 80%, cost reductions of up to 30%, and on-time delivery improvements to over 99%.

For more information, check [www.qrmcenter.org](http://www.qrmcenter.org), join our QRM LinkedIn group or contact us directly at 608-262-4709.



Center for  
**Quick  
Response  
Manufacturing**

University of Wisconsin-Madison

3160 Engineering Centers Building  
1550 Engineering Drive  
Madison, Wis. 53706

EMAIL [qrm@engr.wisc.edu](mailto:qrm@engr.wisc.edu)  
PHONE 608-262-4709  
WEB [www.qrmcenter.org](http://www.qrmcenter.org)