**Between a rock and a hard place**

*When Quarra Stone Co. LLC bid on a 42-page contract with the U.S. Army Corps of Engineers to replace the stone on Washington D.C.'s Cabin John Aqueduct, it at first looked like any other quality stonecutting job. But the corps. contract called for each and every stone to be perfect. That could have put the company between a rock and a hard place, ir it wasn't for lean manufacturing techniques.*

by Paul Markgraff

Perfect stone? Is there such a thing? To the U.S. Army Corps of Engineers, it is the only thing. The corps expects perfection from its suppliers and contractors.

In spite of the daunting task, Quarra Stone Co. LLC, a Madison, Wisconsin-based stonecutter that produces architectural-cut stone, won the job. Its impressive resume includes work in the lower 48 states. Government work is one of its specialties.

“There are less expensive ways to do what we do with lower quality,” says Jim Durham, president of Quarra Stone. “We get business because the people we work with appreciate high quality.”

**Simple job? Yes and no**

Cutting stone for the aqueduct, a bridge-like structure outside of Washington D.C., shouldn’t be a difficult job. After all, if Quarra Stone’s work was good enough for the likes of Harvard and Yale, it should surely be good enough for a government project, right?

Wrong.

The U.S. Army Corps of Engineers is a very demanding client. It placed a quality requirement on the Cabin John Aqueduct project that Durham never saw before. It would accept no stone with chips larger than 1/4". Because stone doesn’t chip smaller than 1/4", it meant the corps ultimately called for no chips at all.

“In our industry, if there’s an area of stone that

doesn't show in the wall, you don't have to worry about the chips," said Durham.

But this time, Quarra Stone had worry in spades. Each stone the company would manufacture costs $2,000 to $3,000, depending on its size. If just one worker made even a small mistake and chipped a stone, Quarra Stone would have to eat it.

Durham puts it in perspective. "I don't think we would make $100,000 worth of bad product, but I think it would be easy to make $50,000 worth."

With a $1 million contract, $50,000 in slip-ups can't be tolerated.

**Enter Wisconsin Manufacturing Extension Partnership**

Fortunately for Quarra Stone, the job coincided with an initiative the company had with the Wisconsin Manufacturing Extension Partnership (WMEP). WMEP helps small- to mid-sized companies get the expertise they need but cannot always afford.

WMEP helped Quarra Stone implement a technique called lean manufacturing into an environment that looks less like a manufacturing plant and acts more like a building site. With lean manufacturing techniques, companies can ultimately eliminate waste from processes.

**A change in culture**

It also helps companies change their culture to be more organized and productive.

"WMEP-style lean manufacturing can help streamline a company, give workers more pride in their own work and return your investment 20 to 1," says Jim Schneberger, WMEP Madison area coordinator.

WMEP helped Quarra Stone figure out how it could meet the strict zero-defect materials requirements for the project.

"You look at every job and you say, 'What's going to be the key factor in this job?'" says Durham. "I don't think we saw that it was going to be material handling."

Schneberger's past training as a process control manager for General Motors Corp. establishes him as a professional at quality, efficiencies, scheduling, organization and helping companies plot a path toward success. At one of the first meetings, Schneberger and Durham identified chipped stone

as a common problem that was very difficult to address.

Always the pragmatist, Schneberger asked Durham, “Have you made one without any chips so far?”

Durham responded. At that point, they made three perfect stones for the project.

That was all Schneberger needed to hear. “If you can make one right, you can make a million of them right,” he said confidently.

**And so it began**

“At first, I thought it was going to be a statistical engineering problem,” says Schneberger. He thought the problem was related to equipment malfunction instead of material handling. The analytical tool, called a Failure Mode and Effects Analysis, helped solve the problem.

Schneberger sat down with the people involved and discussed what can go wrong in each step of the production cycle.

He asked the workers how a stone could be chipped from the time it entered their hands to when it left for the next process.

For each failure mode, Schneberger asked each employee the following questions and had them rank their seriousness on a scale of 1 to 10: How often does it happen; How severe would it be; and What is the likelihood they would detect it?

“We multiply these three numbers together to establish a risk priority number (RPN),” explains Schneberger. “We do that for each failure mode in each step of the production process.

“Once you have identified what areas you must work on, you ask yourself, ‘What is the best way to address the RPN? Do I need to reduce occurrence, reduce severity or improve ability to detect a problem?’” says Schneberger.

With Quarra Stone, explains Schneberger, WMEP found three distinct processes that stood in the way of producing perfect stone. They all turned out to be material handling issues.

**Problems and solutions**

Schneberger’s work found that the most likely time workers would chip a stone was while they made short cuts across the ends of the blocks and while the stones were moved in the facility.

Quarra Stone attacked the problems on several fronts. First, workers improved the shoring underneath the stone, giving it a solid base on which to rest during the cutting process.

They made custom pallets for each stone that allow workers to pick up stones more consistently.

To protect corners during cutting, workers changed their cutting process. Instead of cutting totally through the stone which often chipped corners as the last of the stone fell away, workers left a few inches of stone to be broken off with a hammer, then worked to final size with a grinder.

The second serious problem involved moving the stone within the facility. The shop is relatively small and chances are great a worker could bump the stone while moving it. Also, it was very easy to accidentally hit the stone with equipment or other stones as it was sitting in the factory, waiting for the next cutting step.

**First, training**
To minimize material handling damage, Quarra Stone trained all workers on the importance of perfection on this project.

It also created “landing zones” to protect the stones. Squares were marked on the work floor to delineate stone staging. Employees could only work on a stone when the square for the next operation was empty. This made a safe area for the stones in the plant and it also streamlined the operation because there were no bottlenecks in the process.

The third problem identified by Schneberger was rotating the 3,000-lb. base stones so workers could polish the bottom side. Quarra’s conventional technique used an overhead crane and the corner of a machine table to manually turn the stone. Inevitably, this knocked corners off of nearly every stone moved.

Quarra Stone solved the problem by making the base stone longer than needed, then mounting rotating plates on the ends. The plates were rigged to the overhead crane, then lifted and turned. This worked, but required extra material and labor.

So the company tried something else: It invested in a Positurner that uses a continuous set of slings and an overhead crane to turn the blocks. It eliminated the extra cutting and drilling while keeping the stone even more secure and less

vulnerable to chipping or other damage.

**Chip-free results**
By going through an exercise of lean manufacturing with the help of WMEP, Durham says he taught himself and his company a lesson. It changed the way his company does business, positively affecting work quality and the bottom line.

“I think we did the job for less than we anticipated,” says Durham. “We achieved quality by simplifying the process. We dramatically reduced our defect rate and saved 10 percent of the contract amount. It had that kind of effect.”

**Other benefits**
But the money isn’t everything, says Durham. What WMEP really achieved was making Quarra Stone a healthier business. “The real savings and dollar impact wasn’t just on the Cabin John Aqueduct project, it’s on future work where we continue to develop our process and perfect it. In lean manufacturing the theme remains the same: ‘It’s not over; it’s never-ending.’ Now we can apply the lean manufacturing concepts to the next job and the next one after that.”

At first, Durham wasn’t sure his company could meet such a high standard set forth by the project. But after working with WMEP, he is sure he could do it again with even better results.

"During the first meeting I have with every company considering the lean manufacturing process, they always say, ‘We’re different and our customers are different. That principle doesn’t apply to us,’" says Schneberger. “But after the first meeting, they realize they are not different. They can get control and lean manufacturing will work."

**Eight ways you waste**
The Wisconsin Manufacturing Extension Partnership (WMEP) has a better grip on waste than a trash compactor. It helps identify the following hidden sources of waste in participating companies. Are any of these in your company?

**Overproduction**
Overproduction is making more product than required, making product too soon, or making it faster than required by the next process. Some causes include:
• “Just-in-case” logic
• Misuse of automation
• Long setup processes

• Unleveled scheduling
• Unbalanced workload
• Over-engineered products
• Redundant inspections

**Inventory waste**
Inventory waste is any supply that is in excess of a one-piece flow through your manufacturing process. Some causes include:
• Need for buffer against inefficiencies and unexpected problems
• Product complexity
• Unleveled scheduling
• Poor market forecast
• Unbalanced workload
• Poor communications
• Inappropriate reward system
• Unreliable supplier shipments

**Defects**
Defects are poor-quality products that require inspection and repair to meet customer expectations. Some causes include:
• Weak process control
• Poor quality
• Unbalanced inventory levels
• Poor planned maintenance
• Inadequate education/training/work instructions
• Poor product design
• Customer needs misunderstood

**Processing waste**
Processing waste is effort that, from a customer's viewpoint, adds no value to the product or service. Some causes include:
• Product changes without process changes
• "Just-in-case" logic
• Customer requirements not clearly defined
• Over-processing to accommodate downtime
• Lack of communication
• Redundant approvals
• Extra copies, excess information

**Waiting waste**
Waiting waste is the idle time while workers wait for anything. Some causes include:
• Unbalanced workload
• Unplanned maintenance
• Long process setup times
• Misuses of automation
• Upstream quality problems
• Unleveled scheduling

**People waste**
People waste is not using people's mental, physical and creative abilities as effectively as possible. Some causes include:
• Old-guard thinking, politics and business culture
• Poor hiring practices
• Low/no training investment
• Low pay, high turnover strategy

**Motion waste**
Motion waste is any movement of people or machines that does not add value to the product or service. Some causes include:
• Poor people/machine effectiveness
• Inconsistent work methods
• Poor facility or cell layout
• Poor workplace organization and housekeeping
• Extra "busy" movements while waiting

**Transportation waste**
This involves transporting parts and materials around the plant unnecessarily.

Some causes include:
• Poor plant layout
• Poor understanding of the process flow for production
• Large batch sizes, long lead times and large storage areas

**Looking for a way to cut waste? MEPs can help**
Eliminating waste and saving money are not tasks. But the Wisconsin Manufacturing Extension Partnership (WMEP) and the similar entity in your area may be able to help you do just that. There are more than 70 locations nationwide, says Jim Schneberger of WMEP.

MEPs originated through the National Institute of Standards and Technology (NIST) within the U.S. Department of Commerce. WMEP and other MEPs holds classes for companies that wish to operate more efficiently. Offered at local technical colleges, the Lean 101 course, for example, is the introduction to lean manufacturing concepts.

There is cost, but a great return WMEP fees vary by project and are structured to be affordable for small and mid-size manufacturers. In 2001, WMEP projects a positive impact of $50 million

with Wisconsin companies it serves.

“Typically, we deliver about a 20 to 1 return on investment,” says Schneberger, “so, it’s a good value.”

To contact the Manufacturing Extension Partnership nearest you, call (800) 637-4634, or go to the Web site at http://www.mep.nist.gov. You can also circle Item No. 155 on the Reader Response card.

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