

FEATURE FOCUS: *Manufacturing*

staying alive

Forget competing with China on price. These U.S. manufacturers have found ways to earn their bread.

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Liberty Brass Turning Co. Inc. is exactly the type of company that low-cost Chinese imports should have swept away by now.

A small machine shop with 40 employees and sales of \$5 million, Liberty is located in Queens, one of New York City's five boroughs. Doing business there is expensive. Compared with manufacturers in other parts of the country, Liberty pays more for wages, rent, utilities, shipping, and services. It faces high taxes and assertive regulators.

Liberty's CEO, David Zuckerwise, who owns the company with his brother Peter, has seen friends and competitors shut their doors. He estimates that far more than half the milling capacity in New York, Connecticut, and Massachusetts has closed over the past decade.

Yet Liberty is thriving, thanks to insights gained from Zuckerwise's first exposure to Chinese competition in 1987. "We had a major customer that gave us \$800,000 to \$900,000 annually for lighting-fixture parts," Zuckerwise recalled. "We were charging \$1.84. The Chinese quoted \$2.10 to \$2.15, but included assembly, plating, and polishing, so it was a much better deal.

"The next year, the Chinese said to them, 'We're making the assembly. Why not let us make the entire product?' The third year, the Chinese went directly to the stores and basically put our former customer out of business."



Mercury Marine's Verado engine original fuel module had 40 possible leak sites. A redesign reduced the leak potential and cut costs enough to make it profitable to manufacture the module in the United States.

Zuckerwise saw the writing on the wall. Compared with his small shop, China's good-enough quality and very cheap labor gave it an insurmountable advantage in high-volume machining. But Liberty had an advantage, too. It could respond much faster than the Chinese.

"At best, it takes five to six weeks to ship goods from China through U.S. customs," Zuckerwise said. "Using air freight doubles or triples the cost. I can deliver in three or four days. Nobody can come within two weeks of that."

Nor does China compete on smaller orders. Chinese manufacturers like to optimize equipment once, then throw cheap labor at large-volume production. Switching rapidly between runs of 500 or 1,000 parts is complex, expensive, and time-consuming. It dilutes China's advantage in labor.

To compete in custom manufacturing, Liberty had to reinvent its business. Its milling machines, for example, used cams to control the motion of each cut. Liberty had to cut a new cam for each new part it milled. By retrofitting some mills with computer numerical controls and servos, Zuckerwise could program cuts directly without cams. This slashed setup time by 30 to 40 percent and boosted productivity by 25 percent.

Zuckerwise also invested \$35,000 to \$45,000 in cost and estimating software from Global Shop Solutions and MicroEstimating Systems. According to Zuckerwise, "We paid for the software with the money we saved on just one large hex nut."

Liberty made the nut in runs of 75,000. The job appeared profitable in terms of raw materials and labor. When the software analyzed the cost of machinery maintenance and downtime, Zuckerwise found he was losing \$14,000 per run. Outsourcing the job to a U.S. firm with specialized equipment turned the loss into a \$28,000 profit.

Computerization also enables Liberty to quote on jobs the same day requests come in. "When someone needs it now, price is less important than speed, service, and quality," Zuckerwise said. Liberty's fast turnaround commands premium prices that offset the high cost of doing business in New York.

Yet Zuckerwise has not abandoned commodity milling jobs. Instead of doing them, though, he outsources high-volume runs—about 30 percent of his business—offshore.

"We export work that is no longer competitive to make in America," he said. But he only takes jobs that he can produce or rework in his own shop, if an offshore supplier fails to deliver the proper goods. "If you go overseas, you're at the mercy of your supplier for delivery and quality. Mistakes are extremely difficult to rectify. If you buy from me, I guarantee you'll get the part on time and on spec."

Tidal Wave

Liberty is a survivor because it has found an advantage that lets it compete with Chinese imports. Yet cost pressures have made low-cost offshore imports part of Liberty's business plan.

This is because China has pervasive competitive advantages, according to Oded Shenkar, the Ford Motor Co. Chair in Global Business Management at Ohio State University's Fisher College of Business. He is also author of *The Chinese Century: The Rising Chinese Economy and Its Impact on the Global Economy, the Balance of Power, and Your Job*.

According to Shenkar, China uses access to its 1.3-billion-person market—with a middle class larger than the populations of Germany or Japan—to lure investment and technology transfer from Western and Asian companies that want to sell there. Fully half of its exports now come from multinationals taking advantage of low-cost labor.

China is absorbing new technology faster than any country in history, and ripping it off just as fast. "There are definitely significant sectors of the economy that are addicted to violating international intellectual property rules," Shenkar said. "China's present regime's legitimacy rests on its ability to create economic growth. If it comes down to conflicts with the West about patents or closing factories and creating social unrest, it is very clear which way the decision will go."

According to Shenkar, that creates a problem: "The United States is an innovative country, but if China steals our ideas, how do we get paid for innovation and how do we sustain it?"

What's more, the Chinese are cutthroat capitalists. They slash prices relentlessly, steal customers, and recruit one another's employees. Some of China is still very traditional, but its business sector learns quickly, adopts fluidly, and reaches out for specialized business and engineering skills. And its workers earn only a few dollars per day.

"My basic message is that competing on cost with China is basically dead," Shenkar said.

Yet U.S. firms have found ways to compete. They have improved response times and factory flexibility. They have slashed costs through better design and improved equipment maintenance. Many have played their own China card to stay in business. Manufacturing in the United States is clearly not dead, but it is changing.

Redesigning Costs

An old adage states that if your only tool is a hammer, every problem looks like a nail. The hammer at the Mercury Marine division of Brunswick Corp. in Fond du Lac, Wis., was aluminum casting. Mercury, which makes boat engines, became an

aluminum expert because the metal resists saltwater corrosion. By finding a new tool—molded plastic—Mercury not only improved corrosion properties but also slashed costs enough to stop outsourcing and make a component in the United States.

The fuel module draws gasoline from the fuel tank, cools it, and then pumps it under pressure into the fuel injector. The original version consisted of extruded, stamped, and welded aluminum housings with stainless steel and brass fittings. Clamped hoses tied the system together.

"I never finished counting the parts, but I did count 40 potential leak sites and every one of them was susceptible to galvanic and crevice corrosion," said Kevin Anderson, Mercury's manager of metallurgy, chemistry, plastics, corrosion, and structural testing.

Molding the housing from glass-filled DuPont Zytel nylon resin integrated dozens of parts and removed 31 potential leak sites and all but one corrosion site. "We eliminated everything but the nylon, stainless screws, and one machined bolt hole," Anderson said.



Elnik Systems keeps costs under control by importing expensive molybdenum and tungsten furnace metals from China. It also outsources predrilled molybdenum furnace tray preforms, but must bend them into shape in the United States to achieve the quality it requires.

The new design housed both fuel pumps in the module and

eliminated complex hose interconnections. "Instead of all those hose clamps on the production floor, we now use integral quick connects," Anderson said. "Click, click, click, and they're done."

Best of all, the new module cost \$25 less than the original metal assembly, and reduced assembly time by 25 to 30 minutes because of the reduced part count and easier connections. The savings were enough to let the company stop outsourcing and bring module production back to the United States.

The project changed how Mercury approached design. "When I first came here, everyone wanted to make aluminum castings," Anderson explained. "But when we stepped back and looked at it, plastics opened a new world for us. We started to look at the total fuel system instead of individual components and realized we could save a bundle of money."

According to Anderson, "The project helped us remember what clean engineering design is all about." Mercury has now set up an advanced design group to look for ways to re-engineer its product line. It has also invested in software from Boothroyd Dewhurst Inc. of Wakefield, R.I., to enable it to make better tradeoffs among design, part integration, assembly, and cost.

"Our competitors are large corporations, but if we can come up with lean, clean designs, we can stay ahead of them," Anderson said.

Manufacturing is less a driver for the Elnik Systems division of PVA MIMtech LLC in Cedar Grove, N.J. The company makes only about one metal injection molding (the "MIM" of the name) furnace each month. Technology gives Elnik its edge and encourages founder Claus Joens to believe he can sell his furnaces to China.

Metal injection molding produces small, intricate parts, such as gears, connectors, and housings, that require no machining. It works by injecting a mixture of metal powders and plastic and wax binders into a mold. The parts then go to a debinding furnace, which slowly boils off the binders without disturbing the shape of the powders. After cooling, the fragile parts go into a high-temperature furnace where the powders solidify into strong metal parts. The whole process takes 24 to 48 hours.

Elnik's innovative furnace combines those two heating steps into one, slashing total process time to 12 to 18 hours. It does this by reducing the turbulence of the furnace gases flowing around the parts. This controls part temperature precisely enough to speed debinding and produce higher part yields.

The technology is not patentable. Some of Elnik's secrets, such as the arrangement of holes where gases enter the furnace, are readily visible. Others, such as how it calibrates furnace gas flow, are embedded in the controllers. Chinese scientists could probably reverse-engineer the design within two years.

"I think I can convince them that they're better off getting good parts at high yields than spending years on reverse engineering," Joens explained. "The Chinese are still playing catch-up in this technology, and they're going to need top-notch components to supply their auto industry. Besides, even if they want to copy it, it will not be substantially less expensive if they build it themselves."

That is because Elnik monitors costs carefully. The company cross-trains workers so they are always busy. It redesigns furnaces to use more standardized parts, and outsources as much manufacturing as possible to regional specialists.

Equally important, Elnik sources expensive high-temperature furnace metals and even some components from China. The deal saves Elnik 30 to 40 percent on the \$1 million to \$1.5 million it spends on molybdenum and tungsten each year.

Although Elnik buys predrilled molybdenum furnace trays from China, it must anneal and bend them itself. Still, it is a bargain. "It costs about \$210 for a finished plate," Joens said. "If I did everything here, it would cost \$300 for the molybdenum alone and about \$400 for the finished plate."

If Elnik outsources to cut costs, Flinchbaugh Engineering Inc. profits by persuading large companies to transfer entire production lines to its York, Pa., factory. So far, it has sold Alpha Laval, Caterpillar, Mack Trucks, Siemens, and SKF on the notion that line transfer is a viable alternative to make-or-buy decisions.

"We live off of the crumbs the big companies don't want anymore," said Flinchbaugh's president, Michael Lehman. "Those crumbs look big to us."

Like many companies in niche markets, Flinchbaugh discovered line transfers almost by accident. In 1986, Caterpillar wanted to outsource a 250-part line of clutch pistons it planned to replace. Flinchbaugh won the job and Caterpillar sent all of its production equipment to York.

"If you outsource a part you're already making, there's a huge amount of value in the product and plant that you literally throw away," Lehman said. Many products have years' worth of black book modifications that never appear in engineering drawings. Some processes, such as a valve lifter with a hot isostatic pressed tungsten carbide tip that Flinchbaugh makes for Mack, involve specialized process knowledge.

Offshore manufacturers need to reinvent the wheel with each new outsourced project. Transferred lines include that information, Lehman said. It is especially valuable when manufacturing a large, complex line of products.

To make transfers work, Flinchbaugh needs high productivity. This starts with a highly motivated workforce that is halfway through an employee buyout. "There are a whole lot of owners walking through the factory every day," Lehman said.

The company also revitalizes older equipment. Large companies devote fewer resources to optimizing older lines. "We have a staff of 10 engineers that constantly tweaks our lines," Lehman said. "We try new coolants, new tooling, and new approaches we learn from other lines we bring in."

Flinchbaugh is quick to apply maintenance solutions. Several years ago, workers found a coolant leaking behind one machine. After cleaning the unit, they placed a piece of plexiglass over the back. According to Lehman, they discovered metal shavings were building up and blocking the coolant trough.

The company applied plexiglass windows to other machines and a motor that arced and shut down when its brushes got dirty. "We only noticed the problem when the machine stopped running," Lehman recounted. "After covering the motor with plexiglass, we could see the sparks and call maintenance before we damaged the motor. We also started adding windows to detect frays on belts before they break."

Making old equipment more reliable gives Flinchbaugh extra

capacity, which it uses to bid for other work. "We run 24/7, and since we're not buying all our equipment, we can offer lower prices," Lehman said.

Brand Power

The production of many hand tools has moved overseas during the past decade. Vise-Grip locking pliers should have been among them. Based on a simple spring lock that clamps the pliers onto a workpiece, Vise-Grip's patent ran out decades ago. Just about every American hardware store sells a knockoff made in China.

Yet each year, Irwin Industrial Tool Co., a division of Newell Rubbermaid Inc., makes about 10 million Vise-Grip pliers at its one plant in DeWitt, Neb. It exports millions of units to Asia.

Instead of moving production offshore, Irwin's reputation lets it charge premium prices for its brand. "We believe tradespeople place a value on 'Made in the USA,'" said engineering director Tom Chervenak. "But they won't pay extra unless they get value for that extra dollar they're spending."



Elnik's Claus Joens estimates the Chinese could reverse-engineer his furnace within two years, but feels he can get them to buy systems instead.

Irwin delivers that value by understanding how people use its

tools. "We do lots of research," Chervenak said. "We send people out to observe how tradespeople actually use our tools." The result has been specialized Vise-Grip pliers for welders, plumbers, and craftsmen who frame offices with metal.

Irwin's tool tests mimic real-world use. "By doing that, we can impart performance to the tool that a person can really feel," Chervenak said. "We like to think of the Vise-Grip as the tool of last resort. If someone needs to loosen a rounded-off fastener and it comes through, we've won that person for life. So we pay real attention to quality."

Irwin pays equal attention to cost. It sets aggressive cost goals each year, relying on employee teams and ongoing investment to drive down unit costs. It has reduced headcount, sought better deals from suppliers, and even outsourced its warehouse.

Over the past five years, it has reorganized its factory flow into work cells, where parts move quickly between each machining operation. This eliminates inventory and enables workers to react to quality problems as they arise without creating bins of scrap or rework.

Reducing costs cuts the premium Irwin needs to charge to profit from making Vise-Grips in DeWitt. As long as "Made in America" means a better product, it can continue to do that.

In many ways, the engineering plastic injection molding business of Donnelly Custom Manufacturing Co. in Alexandria, Minn., resembles the short-run, fast-turnaround model of New York's Liberty Brass Turning.

Donnelly, however, got into the business 21 years ago because of domestic competition. "When we knocked on customer doors, they didn't exactly say, 'Wow, we really need someone to make our parts,' " company president Stan Donnelly recalled. "So we focused on short-run jobs other companies didn't want. We did it out of desperation."

In for the Short Run

Today, Donnelly molds scores of different products each week. "There's an index called the complexity factor, which is equal to a company's machines times molds times number of materials run,"

he explained. "If the number is over 300,000 or 400,000, you're considered complex. Ours is around 10 million."

Donnelly makes it work by going against the grain. He has a very high man-machine ratio compared with other molders. He deliberately underuses equipment so that machines are available to handle rush orders. Donnelly is a master of fast setup times. If the setup takes longer than half an hour, he said, he has lost his profit on the job.

Like other custom manufacturers, Donnelly supports a relatively large staff of engineers. "We're in there at the cocktail napkin stage, because design is where you can save 25 percent of production costs," he said.

Workers spend 100 hours annually training in everything from resin chemistry to statistical processing control. "When you squeeze a resin into a mold under heat and pressure, its properties can vary as much as 30 to 50 percent," Donnelly said. "We can either have managers running around adjusting every machine or we can train our people to do it."

Despite his success, Donnelly worries about America's manufacturing future. His company once made all the roller assemblies for in-line skate pioneer Rollerblade. Donnelly exited the business before it all went to China. Now he questions whether other startups would go to a local source or deal directly with China.

"If someone wants to make \$1 million worth of parts from one mold, they can ship it to China and get 30 percent off," he explained. "Long-run molding is simple, easy, and predictable, so it's goodbye, America; hello, China."

"I believe in competition, but this isn't about competition," he said. "It's about short-term profit and shortsighted business practices. When Henry Ford built the Model T, his goal was to make a car his own workers could afford. Today, we're taking those same workers and sending their jobs to people working for 50 cents per hour."

Yet Donnelly, like so many other manufacturers who have survived the growing onslaught of Chinese competition, said he buys a significant fraction of molding tools from China. "Working with Chinese suppliers is no different than working with Americans," he explained. "Some are good and some bad."

"Sometimes you get your fingers burned, but to stay competitive you have to keep touching the stove."



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