Holding Fast, Bouncing Back

Business is finally starting to get back to usual in the big gear world, which offers us a chance to look back at the greatest lesson on how to survive an economic downturn.

Alex Cannella, Associate Editor

A Hofmann Engineering forged steel gear being installed in a gold mine in Asia.

Like the rest of the world, big gear manufacturers are finally seeing signs of business returning to "normal." Thoughts about recessions and survival strategies are starting to fade into memories, and as customers in the mining and marine markets are starting to look at expanding their equipment, big gear manufacturers, in turn, are starting to see improving fortunes on the horizon. That said, as we move forward to brighter times, it doesn't hurt to glance back at how we made it this far.

So let me tell you the parable of Hofmann Engineering's Mill Gearing Department. It's a story that affirms some of the most common advice you'll hear during an economic downturn Advice that, heck, I've written multiple times in this magazine myself. Advice that should be taken to heart and not forgotten while we let the good times roll.

When economic downturns happen and times turn tough, the most common advice you'll hear is that you need to scale back and cut costs to keep yourself financially solvent, but you also need to make sure you maintain your core competencies for when the market inevitably starts going back up. A whole hog fire sale might keep your company alive, but doing so also leaves it gutted and left behind when better times come, which can be just as damaging as stubbornly powering through a recession like nothing's wrong. The crucial advice is to make sure you balance it and don't lay off your entire sales force when you're going to need them again in two years.

In Holger Fritz, Hofmann Engineering's manager of mill gearing and site services, own words: "You have to make it through the low times...and then when the high times are coming, then you already have to look the next five years ahead."

For Hofmann Engineering, however, making it through the low times was easier said than done. They're a company that prides itself primarily on exceptional quality and its custom manufacturing jobs, and when the economic downturn came, those were the two things the market immediately threw out the window.

When times were good, the Mill Gearing Department was what the market wanted. But in a recession, they were a department geared to the exact opposite sensibilities of what market conditions demanded. Nobody had the funds to pay for a high end, quality product. But even with the deck stacked against them, they still managed to come out the other side of the recession intact.

But to understand how Hofmann Engineering got there, we need to start almost 20 years ago, when the department's pursuit of quality included a shift to focusing on steel forging. The casting techniques they were already using were cheaper, but according to Fritz, the department was running into regular issues with their cast gears. Often, Hofmann's engineers would put in weeks of work, only to find errors such as small gas holes that only became noticeable in the final stages of machining and reduced the quality of the gear such as small gas holes, and whenever this occurred, Hofmann and their customers were always left with two unfortunate choices: ship the gear as is, warts and all, or start over and spend another 20 weeks making a new gear. For the customer, that meant waiting for parts they might not have had the luxury of waiting for. For Hofmann Engineering, it meant additional overhead costs and reduced profits. It's a situation that nobody benefits from. Eventually, the department had

had enough of being put in that position, and so they turned to steel forging for their gears instead.

Focusing on forged steel turned out to be the right choice. Even if the process was a little more expensive, Hofmann Engineering saw an overall leap of quality in their products and could design higher AGMA-rated gears. For a decade and a half, the manufacturer saw positive returns for the shift in strategy and continued to pursue quality first.

Then what Fritz has dubbed as "the mining crisis" hit roughly five years ago. Business dried up. Customers went into survival mode as the mining market, a primary source of business for Hofmann Engineering, receded. The influx of new projects halted. Suddenly, all the mining industry wanted were replacement gears, the bare minimum they needed to keep their existing equipment functioning and survive until the market turned back upwards, and they wanted them cheap.

"So the focus changed completely in development and so on," Fritz said. "Five years ago, quality, quality, quality, and now it's more cheap, cheap, cheap. This is what the customer wants and you have to trust the market."

Suddenly, the market was favoring cheaper methods like casting that Hofmann Engineering had left on the wayside, and they had to find a way to make up for the higher cost of forging. But the manufacturer had no choice but to follow the market and pivot their business model to meet its new demands. They shifted to manufacturing spare and replacement gears.

It rapidly became apparent, however, that much of how they did business before hadn't prepared them for the aftermarket space. The department had always manufactured batches of spare gears, but they had specialized for some time in doing one-off custom gear manufacturing jobs. During the recession, their projects became predominantly for replacement gears instead, while the custom projects became less prevalent.

When taking on custom gears, every assignment was a unique challenge with its own set of requirements that Hofmann's engineers needed to meet. That meant a lot of time tweaking and optimizing gear designs to make the highest quality workpiece they could. None of that expertise could be utilized when Hofmann had to switch to manufacturing standardized gears, which not only meant they couldn't leverage one of the department's greatest strengths, but also failed to satiate the engineers' desire for design work.

"On spare gears now, it's a design schism," Fritz said. "You can't optimize. You can't do anything. It has to be interchangeable."

Faced with a market that was rapidly drying up and ran counter to everything their department's culture espoused, switching over to manufacturing spare gears was going to be easier said than done for Hofmann. It was going to take changes in how the department functioned.

The first thing they did was narrow their profit margins to make their forged gears competitive with cheaper manufacturing processes. To reach competitiveness, however, they had to narrow that margin to a razor thin line, and part of that included buying less material for each gear with the idea that they could save money if they machined with narrower allowances. The next natural step was to focus on ensuring accuracy and consistency in manufacturing. Errors meant having to recut or restart manufacturing a gear, and with such thin profits, there wasn't any room for mistakes.

But even with a focus on stringent quality control, margins were still narrow. Everything Hofmann Engineering had done so far was just to keep them competitive in this new market. If they wanted a profit, they needed something more.

It was at this point that management called on the entire department to come together in one meeting. Every employee, not just the engineers, was encouraged to think on where the department could save money or optimize their processes and come up with ideas on how to improve their profit margins.

"This made a big difference for us, to involve everyone," Fritz said. "Not only say 'here, engineers, figure something out [about] what to do.' Get everyone involved. And you would be surprised what good ideas come from the workshop floor."

That difference showed in the department's bottom line, as well. By bringing the heads of everyone in the department together and implementing the suggestions they came up with, the Mill Gearing Department's profit margin went up by 10 percent over the next two years. They had stabilized, and even if perhaps they weren't making money hand over fist, they had successfully hunkered down for the winter, so to speak.

Fast forward to today, and the snow has started to thaw, to be sure, but winter still isn't quite over for Hofmann Engineering Mill Gearing Department yet. Business is heading in the right direction, and those custom orders are starting to trickle back in. According to Fritz, South America and Africa in particular are becoming noticeably active markets again. But business has yet to recover to where it was before the downturn. The manufacturer's home market of Australia remains slow to recover, and they continue to look for ways to make their manufacturing pipeline more efficient and push that margin up a little bit more.

However, Fritz says that the department has a lot of plans "in the pipeline," though nothing is ready to be talked about yet. And arguably, the department is stronger than ever. They held out without losing any of their core competencies while also innovating their manufacturing process. The lessons they learned fighting through the past few years will serve them well in both good and bad times to come, and they're already positioned to take advantage of returning demand for custom projects. It's a parable with a happy ending on the horizon.

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Brass Tacks with Klingelnberg

Looking on the more practical application side of big gear manufacturing, Klingelnberg's Drive Technology Division has innovated its way past a few challenges a bit more technical in nature while wrestling with the economics of an entire market.

One challenge that the Drive Technology Division ran into was finding alternative markets and applications for their products and innovations. One primary selling point for the division was their core competence in heat treatment and having furnaces large enough to treat their products. Heat treatment is a critical, arguably non-negotiable, part of the gear manufacturing process; you just can't make the same quality of gears without it.

"Especially when it comes to durability, heat treatment is a very important factor that makes a big portion of the final quality of the gearset," Michael Mohr, sales manager of Klingelnberg's Drive Technology Division, said.

This made Klingelnberg appealing for big gear manufacturers, but it was a challenge to find markets outside of their established customer base.

The solution was simple in an "easier said than done" sort of way. The Drive Technology Division managed to enlarge their global business in the mining industry by offering case hardened and hard finished gears in dimensions and qualities that have never been manufactured before. In addition, the interchangeability with existing gear designs can be guaranteed, which is an important factor especially for the aftermarket business. Klingelnberg took the challenge to apply their experience from the marine industry's applications to even bigger dimensions within the mining industry.

"[Case hardening] allows our customers to downsize their equipment, which is a very important factor, of course," Mohr said.

According to Klingelnberg's Drive Technology Division's Head of Calculation and Design, Rudolf Houben, power density is a common consideration, especially in the marine sector, which accounts for a large segment of the division's customers. In applications that include a propeller, gearbox size, and by extension, power density, becomes an important factor.

"The bigger your gearbox is, the less of the surface of the propeller can be active," Houben said. "So if you have a big gear in the final stage, then you have a big shadow effect coming from the gearbox, reducing the efficiency of the propeller."

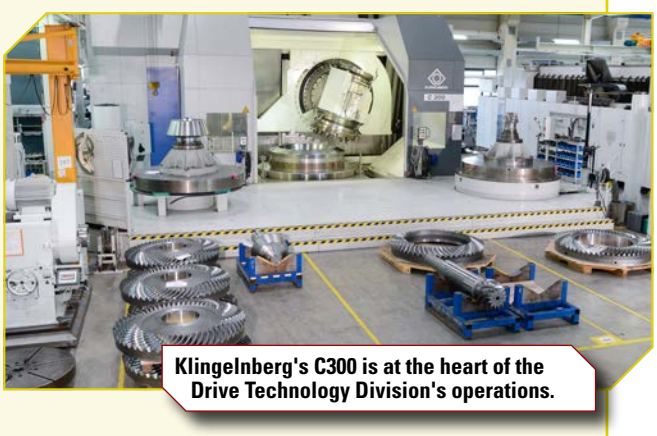
According to Houben, the division has achieved a higher power density in their products by utilizing Klingelnberg's well-known simulation software to produce more detailed information on how the gear would perform during operation. By taking this information and implementing it into the design of their gears to optimize their behavior under load, they've managed to either reduce the size of their gears while maintaining quality or increasing the rated power for a given size of gears.

Everything on the factory floor is Klingelnberg-built. Design software, gear cutting, grinding machines, precision measuring centers, tooling, workholding, and more; the Drive Technology Division works with a single, comprehensive suite composed entirely of Klingelnberg products from start to finish.

And at the center of the division's operation is the C300, a cutting machine capable of working with spiral bevel gears up to 120 inches in diameter. The machines also allow the Drive Technology Division to soft and hard cut gears at both a faster pace and a higher quality than they could previously thanks to the numerical controlled machine tools and its additional degrees of freedom it's capable of performing.

One addition to Klingelnberg's suite of products is the introduction of a Virtual Master, a sort of digital twin version of a test prototype. The Virtual Master is an entirely digitized copy of a gear primarily used for designing and testing gears before their manufacture. By utilizing a wide swath of data from tests conducted across several universities, it can accurately simulate the performance of a gear just as well as a physical prototype would in the actual field, and by its digital nature, can shave off weeks, if not months, of back and forth and shipping costs that would normally be required to test that prototype.

In addition, it can also be utilized to get rid of physical master gear sets for contact testing in order to proof interchangeability of each individually produced pinion or ring gear. While the Virtual Master was first introduced for smaller gears, Klingelnberg also utilizes it for larger applications in the marine industry, and they keep on working to further implement the technology in even more mining applications.



Klingelnberg's C300 is at the heart of the Drive Technology Division's operations.

There are a whole host of new technologies alongside the Virtual Master that the Drive Technology Division are investigating currently: full digital twins all along the process chain, additional cutting processes, condition monitoring and superfinishing, to name a few. Many of these concepts are still experimental and used only on a case-by-case basis, but we'll no doubt be hearing back from Klingelnberg about in the future as they become more standardized.

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