Identifying Equipment Failure

How Machine Tool Maintenance Has Evolved in Recent Years in Gear Manufacturing

Matthew Jaster, Senior Editor

A quick jump into the virtual time machine (with assistance from the *Gear Technology Library*) will uncover dozens of articles on machine tools. It's actually a fairly entertaining experiment to see what was happening at IMTS in 1996 or Gear Expo in 2011.

23 years ago, machine tool manufacturers were combining tasks like hobbing, deburring and rolling into one unique system that needed a single operator. They were introducing Windows-based software for shaper cutters, broaches, end mills and hobs on a grinding machine. Eight years ago, employment was increasing, lead times were extremely long and the need to make higher quality gears was challenging due to a shortage of gear manufacturing capacity.

No matter the year or the technology in question, the gear industry is only as strong as its equipment and its operators. You can travel back to 1996 or 2011 or fast forward to 2025 and find that machine tool maintenance is vital to manufacturing gears, past, present and future. Lucky for us, it seems to be getting easier as the technology advances.

"Maintaining optimal productivity requires first class machines. This can be further optimized by an investment in operators and maintenance staff training as well as regular maintenance of the machine which shall be carried out by the manufacturer or by the customer's proficient technicians," said Loïc de Vathaire, head of service bevel gears, at Klingelnberg.

Billy Rodgers (a lead gear machine builder at Bourn and Koch) assembling a B&K 100H gear hobber.

Loyd Koch (left, one of the original founders of Bourn and Koch and still works there today) works with personnel on programing a Fellows 10-4 gear shaper.

For Jeff Moore, regional sales manager, Canada, at EMAG, it's all about knowledge. "With practical hands-on training our customers can get the most out of their equipment," he said.

"Foremost, a solid preventative maintenance (PM) program," Adam Gimpert, business manager at Helios Gear Products, said. "This typically begins with manufacturers familiarizing themselves with and following the prescribed PM directions from the machine tool builder or OEM. Additionally, if a manufacturer doesn't have dedicated maintenance personnel, it is wise to have the machine tool's factory-trained technicians perform a basic PM service on an annual or semi-annual basis. Finally, operators must be 'in tune' with their machine tool, which comes with time and experience. This will allow them to raise a red flag when they hear an odd noise, sense an unfamiliar vibration, or see abnormal machine movement."

Personalized productivity is also welcome in the case of Bourn and Koch.

"In order to assist our customers with maintaining the optimal productivity and efficiency of their Bourn & Koch machine tools, we offer personalized Preventative Maintenance Plans (PMP). Individually based on our customer's needs and expectations, our service technicians provide maintenance recommendations, training, and schedule wellness visits either quarterly, semi-annually, or annually," said Rob Swiss, national sales manager—gear machines, Bourn and Koch.

Today's Greatest Hits

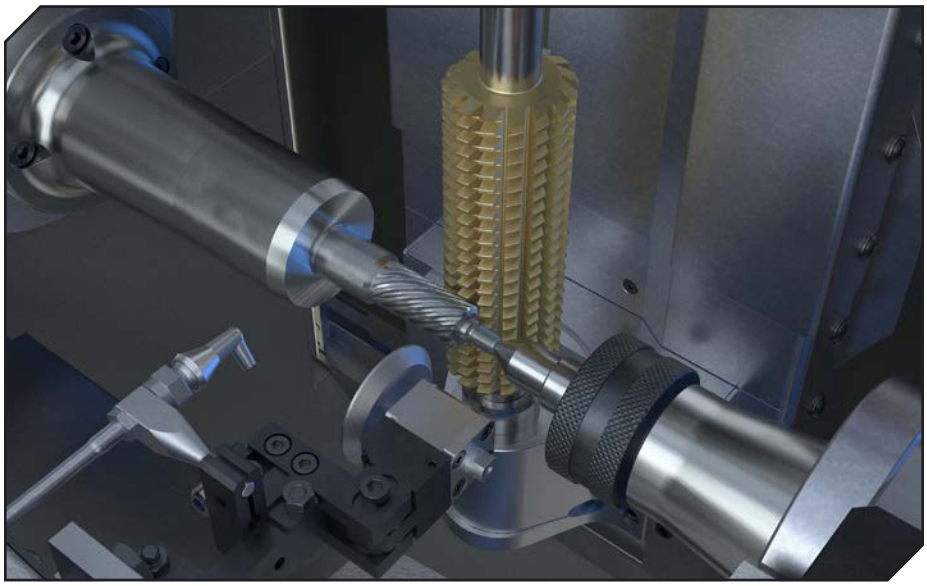
To understand how the technology is improving we must first discuss a few of the leading causes of equipment failure in gear production today. Moore said

that a lack of basic understanding of the machines can lead to a lack of preventative maintenance, poor basic operation and failure recovery procedures.

Gimpert believes lack of maintenance is number one by far. Chips build up, machines are not cleaned, filters are not replaced, oil turns dirty, wipers wear out, and much more. This lack of simple PM results in the outside world (in this case the shop environment) infiltrating the machine's most important internal construction.

"The consequences are drastic: low-tolerance, mission-critical and expensive components become damaged. These may include ball screws, ways, bearings, motors or linear rails. Often, these damaged parts cannot be fixed by in-house maintenance personnel which means expensive service visits from the machine tool's factory-trained technicians," Gimpert added.

"In our experience most failures result from the non-observance of the manufacturer's visual checks, cleaning and maintenance recommendations which is often combined with an over-utilization of the machine. Other causes include operators' mistakes due to a lack of training and the installation of lower quality spare parts vs. genuine approved parts," said de Vathaire.



Hands-on training on EMAG machines is the best way to keep personnel up-to-date on maintenace features and functions.

Mechanically, if you properly maintain the oils and lubricants as well as pay mind to common wear components, a machine should hold up for a very long time, according to Chad Webster, sales engineer — gear machines, Bourn and Koch.

"Electrically, the biggest issues we have seen are the obsolescence of components, in older machines. Also, we have noticed that if the consistency & PH of water-based coolant is not maintained, it can breakdown seals and sometimes

cause the paint to peel," Webster said.

Like anything else in manufacturing and engineering, success or failure starts with the components.

"We fully understand the challenges of maintenance departments within the gear industry i.e. scarce maintenance resources while production interruptions have serious consequences. Therefore we install the best-in-class components that are fit for purpose within a 24/7 production environment. In addition, we use modern remote maintenance tools and advanced diagnostics features in order to quickly troubleshoot issues and identify worn parts," said de Vathaire.

Gimpert discussed how the technology today helps machine tool maintenance. "Generally, modern machine tools are better engineered, which results in excellent fit and finish, and offers improved design features such as modern enclosures and containment of critical components from potentially damaging production environments," he said.

And IIoT/Industry 4.0 solutions continue to give gear manufacturing the upper hand in machine tool maintenance.

Klingelnberg's Training Center preps machine operators for the latest machine tool developments.

"EMAG machines are ready for the future with our Industry 4.0 Solutions and our ServicePlus app. These services allow our customers to have their machine tools networked with humans as controllers in the value added chain," Moore said.

One example of this is EMAG's Fingertip solution. Fingerprint will help EMAG customers increase machine availability and productivity whilst reducing costs. Prior to shipment of a machine, EMAG can perform a detailed Fingerprint analysis on each of the machine axes. This detailed Fingerprint diagnostic report gives a reference measurement (a baseline) on the condition of mechanical components, which can

now be compared in the future to assess machine operation. "The best part is that no expensive dismantling or assembly work is required to perform the evaluation. Using the data provided by Fingerprint, you obtain an up-to-date machine status report," Moore added.

A second example would be the EMAG ServicePlus App (for Android and IOS) together with EMAG Remote Experts. This service can improve downtime with a timesaving's of up to 98%. With the ServicePlus App you can scan the QR Code located on the machine and get connected with EMAG Service at any time, regardless of the location — mobile support always within reach. "Additionally, with Remote Experts our customers are on the fast track to customer help with access to EMAG's entire expertise at the push of a button. With a secure EMAG VPN on-line connection and 24/7 telephone support customers can get help with any machine issues or spares parts needs," Moore said.

The Art of Training Personnel

Klingelnberg currently use multiple channels in order to keep customers informed. This is vital to machine operation.

"We definitely recommend our *Gears Inline* magazine since it includes excellent papers from industry experts. Our applications engineers and service technicians use every opportunity from formal training classes to service calls in order to convey our new developments and how they are adding value for our customers. Last but not least we run Gear Seminars on a worldwide basis. These two-day events are a unique platform for customers to learn about current technologies, trends and innovations from Klingelnberg experts," said de Vathaire.

EMAG hosts open houses at its corporate headquarters in Salach, Germany introducing its latest technology innovations.

"We also host local Technology Days at EMAG LLC in Farmington Hills, MI every other year during even years. During the Technology Shows, we have presentations from our EMAG technology experts, as well as, industry experts," Moore said.

Gimpert said that job shop customers tend to place maintenance low on a scale of importance and do not take advantage of this type of learning. On the other hand, the availability of such content is limited. Nevertheless, preventative maintenance (PM) of machine tools does not require highly skilled personnel.

"The challenge is implementing a system where such PMs are performed accurately and with adequate frequency. For job shops without dedicated maintenance personnel, a simpler solution is often to allow the OEM to perform the PMs, so the shop's team can focus on manufacturing gears," he added.

Swiss at Bourn and Koch continued the discussion on personalized preventative maintenance.

"These tools can be very helpful to customers, keeping them up-to-date with their routine maintenance. We always include training at the time of machine run-off and offer additional training during installation of their machine. However, we believe it is more effective to customize each training program and

PMP based on the individual customer, rather than create a generalized webinar."

Additional Tools in the Toolbox

What else is available for job shops to optimize their gear equipment and keep personnel up-to-date on the latest technology available in the industry?

"There are many courses available from major control manufactures that can help customers maintain their CNC system and operate their machinery more effectively. Also, by joining AGMA you will stay up-to-date on anything involving gear manufacturing and new technology. We constantly update our website and our machine sales team is always available to answer any questions or concerns," said Webster.

Gimpert said it is important to communicate with their machine tool supplier and get to know their service team.

"This can be an invaluable resource to ensuring they get the most out of their gear equipment. Secondly, trade shows such as the upcoming AGMA MPT Expo offer a one-stop source to see the latest in equipment, learn modern methods of maintenance, and compare different supplier solutions." he added.

Moore said that utilizing the latest media resources available to every company is another great way to keep personnel informed and current on machining technologies.

"We have an EMAG YouTube Channel where we often post new videos. We also do postings on LinkedIn making our customers aware of EMAG product releases and new technology news as well as classes through our EMAG Academy. These courses can be taken to keep your team up to date on the latest technologies and how to use them," Moore said.

Klingelnberg is currently testing the usefulness of augmented reality (AR) glasses, basically the integration of digital information in real time as opposed to an artificial virtual reality.

"We support a significant number of machines and the required expert may not always be able to immediately travel to inspect the machine. However, with smart glasses we can virtually put him in front of the machine so that he can immediately understand the issue and share his knowledge," said de Vathaire.

Smarter Resources, Clever Machines

We've discussed the benefits of remote access programming for machine tools for many years in the pages of this magazine. Today, it is becoming the norm to use these tools for preventative maintenance. This resource is also less expensive—which is a great way for smaller companies to keep up with the technology.

"Remote access programming is readily available technology and extremely useful to smaller shops. The remote access allows the machine tool builder to log into the machine offsite, via the Internet, to diagnose any particular issue the customer may be experiencing. This technology is fairly inexpensive and allows for a quick solution," Swiss said.

Moore said that large and even medium to small customers can take advantage of EMAG's Industry 4.0 solutions. In fact, the smaller shops with less service staff and limited budgets would benefit the most. With the ServicePlus app and Remote Experts it's like having a service expert on call available 24/7 days a week. For those times when service technician is needed, EMAG has multiple personnel stationed in key markets.

Philipp Becher, product management and sales gear tooling, at Klingelnberg GmbH said that the digital twin can be used for maintenance optimization of production equipment as well. It allows visualizing condition and status of every integrated component. During production the machines interlinking the count of produced parts with the used production equipment on the machine. Also incidents like crashes or comments noted by the machine operator are documented an assigned to the production equipment on the machine. This information gives a pretty clear view on the current condition and allows optimizing the reconditioning and replacement of customer's production equipment. (*Editor's Note: He discusses this in length in the May 2019 issue of* Gear Technology *magazine.*)

The Bourn and Koch gear team standing by a Fellows HS1280 gear shaper.

While some of the latest innovations are coming down in price, Gimpert said that many analytics are still prohibitively expensive to implement for smaller shops.

"An industry-leading cloud IoT (Internet of Things) platform costs tens of thousands to utilize *on an annual basis*. Additionally, a manufacturer needs to develop or purchase software integration. And the last barrier is that a pre-internet machine tool likely has no way to offer IoT connectivity," Gimpert said. "Until the economics of these solutions 'trickle down' to smaller shops, we see a more immediate solution in "clever" machines (maybe not fully smart). These

machines offer self-diagnostics and self-monitoring solutions that are not powered by the Internet, the cloud, or big data, but offer powerful maintenance guidance and assistance."

Everyone will be connected to the virtual world in the future, added Moore at EMAG. "With real-time machine production data that includes machine downtime, OEE%, production numbers per-shift. per-machine that are available on your desktop computer, tablet or phone," he said.

"We believe that automated solutions will be on the rise. Innovations like smart sensors, big data analytics and fast communications will enable machine tool users to identify issues before it is too late and to schedule maintenance tasks as required," said de Vathaire. "Down the road, machines will proactively seek assistance when they sense that their condition has been deteriorating."

Machine technology will one day be fully-connected to the Internet, according to Gimpert.

"Machine tools in the future will be fully connected to the Internet, which will allow them to feed data to suppliers of predictive and real-time analytics. This will all be performed securely and seamlessly," Gimpert said. "But that's the future, and we feel *that time* is many years away before becoming the norm."

"In 2019, we see shops still reluctantly rolling out Internet access points in production environments, but this is a critical first step. Suppliers of data analytics still grapple with selling security; the technology is there, but it is uphill work of making manufacturers comfortable with the solutions. And 2019 will still be a year of new smart solutions, so manufacturers will continue to vet what's new, what's existing, and what's proven. In the meantime, existing maintenance programs will likely continue without significant change," he added.

But change *is* coming, and planning now will benefit your components in the future.

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