Desktop Gear Engineering

SOFTWARE TRENDS, TECHNOLOGIES AND MARKET FORECAST

Matthew Jaster, Associate Editor

Non-circular gear segments where corrective action was successfully applied by Dontyne Systems (courtesy of Dontyne).

Design activity in the gear industry—by most accounts—is picking up pace in 2011 especially in the transportation and wind segments, and the global machine industry is clawing its way back from the 2008–2010 debacle. Commercial software providers understand this and, in turn, know that offering substantial product updates, addressing customer requests and bolstering their technical support and training programs is essential to remain competitive.

Why go outside the company to evaluate the design components within, say, a gearbox? This is the question that commercial software providers like KISSsoft, Dontyne Systems, GWJ Technology and Romax Technology must answer when discussing their respective software services. Many argue that calculation procedures can be developed internally and don't bear the same investment risks found from outside vendors.

If a case is to be made for commercial gear software, it starts and ends with a fairly simple concept: permanent maintenance. Software has become a critical tool in gear manufacturing, and as technologies advance, these software tools need to be consistently modified and maintained. The increased challenges of cost pressure, global competition, reduced development times and product liability means that making the extra investment in the right software suite might be worth it in the long run.

"You must have the technical knowledge within the company to succeed. This involves not only software development, but also engineering services, expert assessments and software upgrade services," says Gunther Weser, manager at GWJ Technology GmbH in Braunschweig, Germany.

"In the past, gear engineers just had to design gears to be quiet and durable," adds Barry James, chief engineer at Romax Technology. "Now they have to be efficient as well. This additional target places additional burden on the design process."

The Experience Factor

For more than 25 years, KISSsoft AG has been providing a single niche product to gear customers. "*KISSsoft* is a practical tool that was always extended on some engineer's request," says Dr. Stefan Beermann, CEO at KISSsoft AG. "In the beginning it was Dr. Kissling who wrote the program for

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his own purposes. Now it is our customers that ask for specific extensions. Since we are working in the committees defining the respective standards, we also know—and sometimes influence—the way these standards are growing."

Familiarity with the material never hurts, as well. "A technical lead in software can only be established by actually doing the same work as your clients," James at Romax says. "Romax has done more than 60 NVH projects in the last 10 years, designed automotive transmissions that are made in volumes of over 1 million per annum and has completed dozens of wind turbine gearbox designs, up to 5 MW. We see an explosion in the amount of design activity in gearboxes because of the requirements for low carbon vehicles and wind energy."

At GWJ, the focus is on the detailed and practical implementation of the calculation methods. The company's *eAssistant* and *GearEngineer* software is continually being improved and its functionality is increased based on specific user requirements. "The *eAssistant* is available immediately and requires no installation or maintenance. There are no investment costs. It provides a valuable reduction in time and costs. Users appreciate the fast technical advice and support," Weser says.

Experience and engineering support is the reason many companies choose a software developer over in-house packages or a consulting firm.

"There has always been such software available, usually a consultant that also offers software, but you need a lot of manpower to keep software like *KISSsoft* on a current level," Beermann says. "If someone is willing to work around the clock, seven days a week, he can be very successful in a niche. For a larger package, a larger infrastructure is needed. Since prices were quite moderate in the last 20 years for this type of software, everything beyond Excel spreadsheets is hard to make profitable."

"In the past, OEMs created their own gear software suites, but it is impractical to maintain these packages, as the technical experts who write them inevitably retire or are promoted out of the role," James at Romax says. "In the end they have to be replaced by external packages. There is always a place for smaller companies to service low-tech clients or those companies whose budgets cannot stretch to the quality products, but overall they will remain on the peripheries of the industry."

Creating in-house software also leads to high development and maintenance costs, according to Weser. "The trend is towards using professional calculation software to meet increasing demands. However, smaller guys can compete if they combine both the knowledge of creating software with the calculation of mechanical elements."

Dontyne Systems in England keeps its software suite modular and costs down to allow smaller companies to justify the expenditure.

"We have become very adept at working with large companies to provide a hybrid solution that brings their own calculation methods in a modern operating system while allowing direct comparison with common international standards from ISO and AGMA," says Mike Fish, Dontyne Systems. "We are developing more and more building blocks within the software library to help create a customer-specific solution even faster. This has been applied not only to design and rating tools, but also provided links to system models and CAD packages."

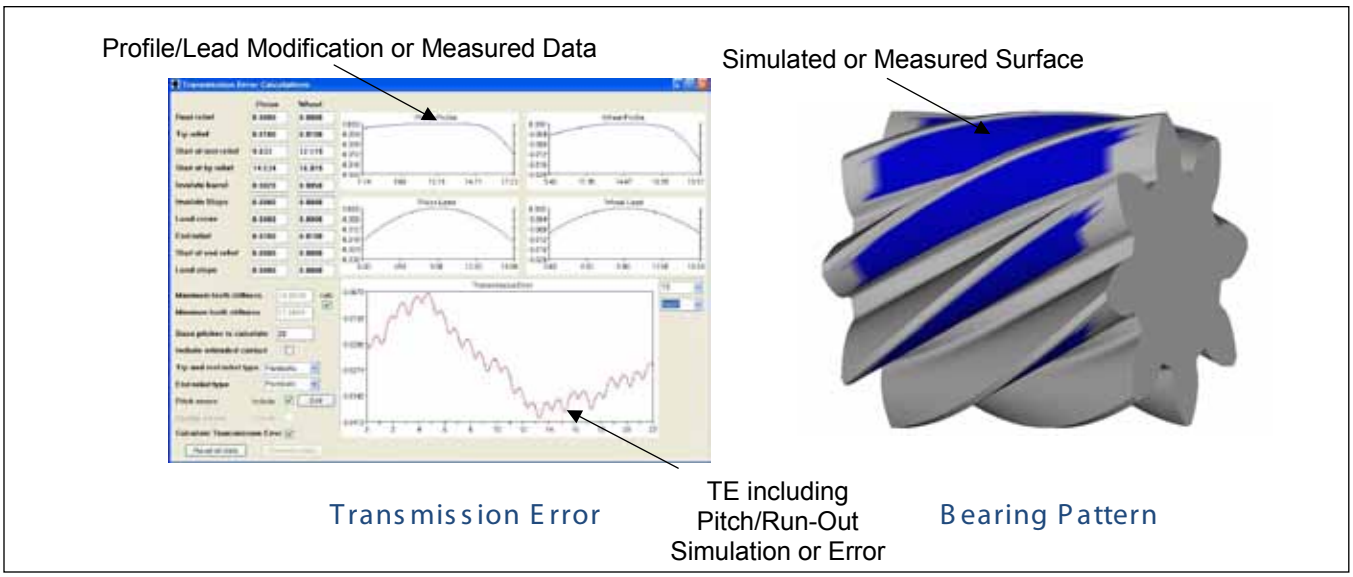
While the market has its fair share of gear-specific software development, making sure the software is being utilized correctly—and efficiently—is an ongoing dilemma thanks to a generational impasse.

The Copy-and-Paste Generation

As was the case in 2008, the quality of gear engineers that have the knowledge to use programs like *KISSsoft*, *RomaxDesigner/RomaxWind*, *GearProduction Suite* and *GearEngineer/eAssistant* isn't what it used to be. Beermann, in fact, believes the issue hasn't gotten much better.

"To be honest, the largest challenge in my opinion is still—and I'm afraid increasingly—the spreading lack of knowledge about gears amongst the engineers. We try to address this with the training we offer. However, since we are a relatively small company we can't do enough training to have a general impact."

"Most of the current students are



Contact analysis model from Dontyne Systems.

not willing to do things like their ancestors, being much more copy-paste oriented. And the universities do not provide the same education as in the past. In Asia there are tons of (engineering) students, some of which are really good," he adds.

GWJ Technology in Germany tries to address the skills issue for both young and old gear engineers by keeping them honest with workshops and training sessions. "Many students already use our web-based calculation software *eAssistant* in the classroom," Weser says. "After they get used to the software, they continue to use it as soon as they start a new job and are able to work efficiently and cost effectively."

No matter how good the gear software is, however, it can never replace the engineers themselves. "Training of young engineers and the retirement of old engineers remains a huge problem. Much of Romax's work involves training engineers on gear technology as well as using the software. This is often mixed in with a consultancy project and/or a bespoke gearbox design project," James says.

Fish at Dontyne Systems believes many gear companies are more aware of this problem today and are addressing it through a variety of initiatives.

"David Brown, for example, has founded a gear academy to teach gear design as a three-year course part time with heavy contribution from industry. An online course is currently being developed at the University of Huddersfield to ensure that there is access to wider and more in-depth knowledge of gear design for trainee engineers. Online learning gives improved access and flexibility both nationally and internationally. I am told from those organizing the course that there has been an amazing and refreshing response to the proposals."

Quality technical support is one area software developers hope will help alleviate some of these issues. Today, support goes far beyond a person on the phone in a remote country telling you which button to press.

"The skills shortage means that you need people in the same time zone and territory to support your engineering needs. To this extent we have engineering offices in the United States, (2), India (2), China (3), Japan (2) and Korea, in addition to the U.K. headquarters. Romax will be adding another in the United States this year and one in Germany," James says.

"To ensure excellent support, in 2010, we launched an online portal where customers can report and track their support issues. This has been very well received by our customers, and we are expecting to solve our 1,000th support ticket later this month. These include a large number of 'what is behind the software?' rather than just 'how do I use the software?' Again, this provides further evidence for the skills shortage and confirms the importance of a strong, technically capable support team," James says.

A variety of workshops are held throughout the year in Braunschweig, Germany for those using software from GWJ. "The user can gain a deeper understanding of basic skills, design strategies or optimizations of machine elements. To provide a good balance between theory and practice,

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This bevel gear set was reproduced using software from GWJ Technology (courtesy of GWJ).

the attendees will have the opportunity to work on their own workstations to complete exercises and to put theory into practice. Individual questions are allowed and welcomed during the workshop. If the customer is unable to join the workshops, GWJ also provides on-site workshops on an individualized basis. GWJ also offers interactive software training sessions over the Web," Weser says.

Dontyne Systems conducts a variety of web conferences in order to support customers and agents from all over the world. "We've given product demonstrations and training to personnel in several international locations simultaneously," Fish says. "Companies find the sessions useful for reducing development time and costs. However, we still find the presence of local agents a massive advantage and have formed relationships in several key countries. The feedback they receive and the knowledge of local conditions is an invaluable part of our complete software package."

Furthermore, Fish insists on actively participating in gear events to meet face to face with gear companies. "We had a very good response after our participation in the AGMA FTM and we'd like to participate in this year's AGMA Gear Expo. We think it's important to meet with companies (or do online demonstrations) as we often find they are under some misconceptions about our products."

Stick With What You Know

If permanent maintenance is the key to gear software development, the companies interviewed for this article are practicing what they preach. Each company has a slew of updates and innovations for their respective software suites (*Ed's note: See* Software Bits 2011 *for latest technologies on page 67*).

While the rest of the software world has turned its attention to mobile technology, gear software providers know that maintaining their classic commercial products will produce promising returns in 2011 and beyond.

Beermann at KISSsoft notes that it remains difficult to "wow" customers in gear design software for many reasons. "We only put a practical twist to what was seen five years ago. The IT industry is currently in the clouds, but it's not something which is really accepted for our type of software. Most technical improvements you see in computer technology do not have any impact on our business."

Dontyne considered developing a web application in 2009, but ultimately decided the demand wasn't there, at least not at that moment. "Despite the increase in mobile technology, we've had no inquires for a web-based version of our applications. Some clients may have security issues with the data transfer and from our own product development point of view it is another set of code to maintain."

Though mobile technology is increasing in other areas, gear design remains fairly basic. KISSsoft recently released a free iPhone app for the conversion of hardness values from one system to another; it's the only mobile application the company currently has. "Although the trend is going into the cloud, we think that for our type of software most users prefer the classical software type, installed on a client or server," Beermann says. "Of course, we are evaluating the different ways for an online version of *KISSsoft*, but nothing is going to happen in 2011."

For the most part, mobile application requests might be offered if the demand increases. "We are always looking at new ways of implementing our technology, and have consistently led the world in technical innovations over the last 15 years," James says.

"Currently, there are no fixed plans to support mobile applications but it can all change if there's enough customer demand," adds Weser. "GWJ is open-minded to new technologies and business ideas online because *eAssistant* already offers a web-based application since 2003."

Concentrating on their core products through the recession has prepared many developers for future gains in the market.

"We were going through the crisis quite well, adapting our structures and organization to more rough times," Beermann says. "This is now paying off, as the gear business is coming out of crisis. The only problem we are currently facing is that we have to restrict ourselves to our core business, because we are running out of staff if we try to do everything requested."

Fish at Dontyne says that the recession marked a cautionary period in software development. "There is no doubt the market was essentially frozen from 2008 well into 2010. We have seen a marked increase in activity since

the end of summer 2010. The biggest challenge at the moment is not to over-extend despite the enthusiasm for our product and the rapid growth we've experienced so that if a recession hits again, we'll have the resources to ride it out. Diversification may be one way of doing that."

With its *eAssistant* software, GWJ sees great potential on an international level, due to an increased interest in "software as a service" (SaaS) and on-demand services to help increase productivity and efficiency. "Also, the user of *GearEngineer* software benefits from several new machining technologies and principles, particularly in conjunction with multi-axis machining centers," Weser says. "The software opens up completely new possibilities for the engineering and manufacturing of gears."

The real difference in the software today might just be the attention and focus on everything other than the gears themselves. "Gears cannot be considered on their own; they are part of the gearbox system that includes the bearings, shafts, housing etc.," James says. "If you consider the gear on its own and ignore the system, then the design will be sub-optimal."

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Software Bits 2011

In order to keep current customers—and gain new ones—software developers have to update their products regularly. Whether it's small intermediate updates or a major release once a year, gear designers have decidedly long "wish lists" for what they'd like to get from their software packages. Developers try to oblige with each new update.

Barry James says the current focus of the software package at Romax includes an emphasis on the design for efficiency, design for manufacturing and design for low noise. The company's latest release, *RomaxDesigner 12.8*, contains an improved module on the *System Design for Efficiency*. It contains efficiency prediction methods that have been correlated against test data and a methodology for designing gears for high efficiency, low noise and high durability. "In fact, given sufficient data, it delivers to the gear designer, in real time, an indication of the g (CO_2)/km saving that arises from changes to the gear design," James says.

Dr. Stefan Beermann, CEO at KISSsoft AG, says the launch of the *03/2011* package comes with a variety of new features and functions including a significant improvement of the 3-D models. "For the generation the *Parasolid* core is used. This opened the possibility to provide accurate spiral bevel gear, globoid worm gears and face gears with arbitrary angle between the axes and offset in addition to the other gear types (spur and helical gears, straight bevel gears). The models have sufficient accuracies for manufacturing and measuring purposes. The contact analysis for cylindrical gears was also extended," Beermann says.

03/2011 now takes the misalignment and deformation of the gear flanks due to shaft deformation into account. "The models of the two shafts can be read from files saved in our shaft calculation. For the optimization of the micro geometry a tool is integrated that varies the flank and profile modifications within the parameters defined by the user, performs a contact analysis for the respective variants and evaluates it with respect to transmission error, lubrication film (micro-pitting), wear and other criteria."

Additionally, the graphical representation now includes 3-D gear bodies with stresses and normal forces marked on the flanks and inputting the tilting and deformation of the rings in bearing calculation. "This is a typical request from the wind business, where the large slew rings on the tower are subject to significant deformations. The same applies to most of the classical gearboxes as well," Beermann says.

GWJ has developed CAD plugins to combine calculation and CAD. The *eAssistant* offers these powerful CAD plugins for different CAD systems (e.g, *SolidWorks*, *Solid Edge*, *Autodesk Inventor*). Other new areas include an emphasis on calculation modules and functions of the *eAssistant* software as well as new types of gears and tooth contact analysis (TCA) in a future *GearEngineer* software release.

Dontyne Systems recently released a products update for its *Gear Production Suite* in April 2011. This update incorporates many of the changes relevant to developments in standards such as micropitting and the IEC/ISO 61400-4- design requirements for wind turbine gearboxes. The company also added new variants to the machine center module for wire erosion and shaving—in addition to the existing hob/grind simulation. At the British Gear Association Technical Awareness Seminar in November of 2010, Dontyne's Mike Fish and David Palmer gave a presentation on "Modelling Production Techniques for Accurate Gears."