transmission TECHNOLOGY INTERNATIONAL

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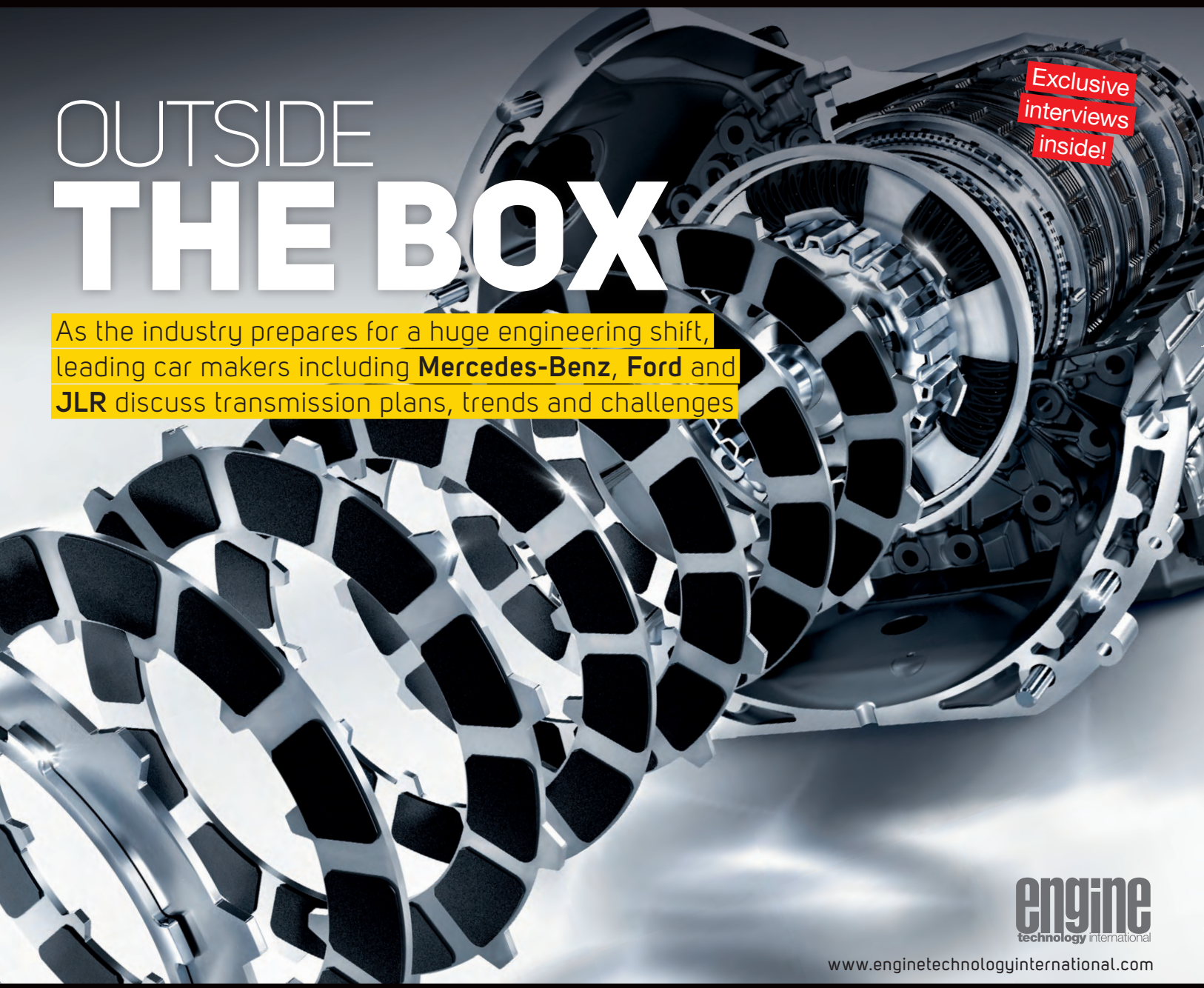

Exclusive interviews inside!

OUTSIDE THE BOX

As the industry prepares for a huge engineering shift, leading car makers including **Mercedes-Benz**, **Ford** and **JLR** discuss transmission plans, trends and challenges

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E-REVOLUTION

Transmission developers are having to deliver all-new technical and innovative designs to meet increasing demand for electric vehicles

PASSING THE TEST

Leading auto industry experts discuss new test, validation and simulation techniques being applied by system developers

GOOD CARS, BAD TRANSMISSIONS

When a brilliant car and engine are designed and developed, but the transmissions tech doesn't quite match the overall engineering package: our top five mismatches of all time

MASTA can accurately and rapidly design transmission systems from scratch or imported concepts

Advances in software development have the power to revolutionize the entire transmissions design process and change the auto industry for good

WORDS: **KARL VADASZFFY**

Analyze to optimize

SMT is a global engineering solutions and services provider that is fully dedicated to providing engineers with the expertise and tools to deliver highly innovative driveline technology and systems.

The company's flagship software product, MASTA, is used throughout the industry as a design, analysis and optimization tool. MASTA is an industry-specific finite element and multibody dynamics analysis software, built with transmissions and drivelines in mind. Functionality covers concept design and detailed design to manufacture.

"MASTA is a tool that enables engineers to design and analyze full transmission systems, including all major gear types and complex planetary gear arrangements," says Dr Paul Langlois, software engineering director at SMT. He explains that bearings can be selected from the in-built bearing catalogs with all major types and suppliers, or from the detailed bearing geometry specified directly. Housings and complex shafts are included via importing FE representations from the major FE analysis tools.

In addition, system-level analyses in MASTA cover static durability analyses, efficiency, frequency domain dynamics for the calculation of system response to transmission error and electric motors, and time domain dynamics.

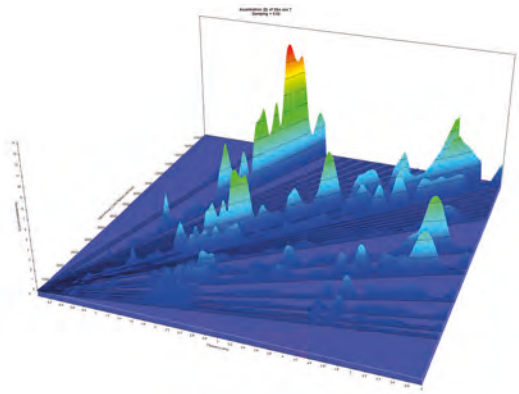
Langlois goes on to explain that component-level analyses analyze the components in the context of the full system-level models. "Implementations of the major international standards are included, taking boundary conditions from system-level models. Beyond the standards, further advanced analyses, such as our advanced loaded tooth contact analysis, are also available." The effect of manufacturing tolerances and errors can be included, and their effect on both the full system and the individual components can be analyzed.

Modern analysis

Multiple tools enable the automatic optimization of gear geometry, investigation of the design space, and the impact of manufacturing tolerances. Batch running capabilities give further flexibility for parametric studies, DOE, optimization, and building MASTA into a wider workflow.

According to Langlois, MASTA is a modern software product built on modern software technology, with no legacy code to maintain. A key focus of the development of MASTA from its inception has been "robustness, usability and extensibility, which has made MASTA a very user-friendly tool, saving customers time and money in building and analyzing models". Furthermore, this makes MASTA more easily adaptable to developing customer requirements and needs.

As well as software, SMT provides engineering services within the transmission industry and has experience in working on transmissions ranging from small electric bicycles to offshore wind turbines. A large proportion of the company's recent work has involved NVH optimization of automotive gearboxes. "With the current trend toward



MASTA can perform full system simulations for any transmission or driveline tech configuration

EVs, less engine noise is placing higher demands on the noise performance of the transmission," Langlois comments. "At the same time, higher speeds associated with newer electric motors call for careful optimization to ensure efficiency and minimal heat generation."

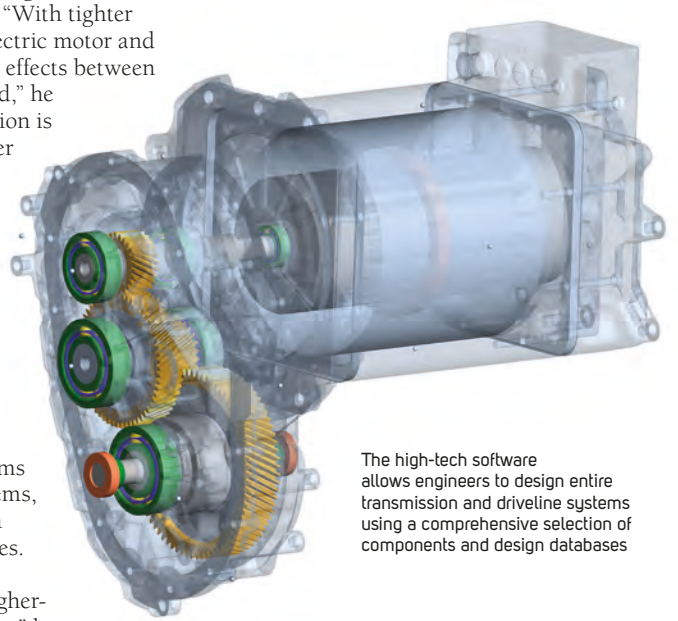
Meeting demand

Langlois reveals that many in the industry are moving toward automation and the integration of the design process, analysis, and presentation of results. "Most engineering problems can be considered as multi-objective optimization problems," he explains.

"The target is to achieve an optimal design for the given application and specification; however, with multiple conflicting requirements, usually no single optimal design can exist. Pay-offs between the multiple targets always need to be considered carefully by expert engineers before design decisions are made." So customers, he says, require functionality that enables a large number of analyses to be run and the results to be presented in a way that enables easier engineering decisions.

"The role of software, then, is to provide a user-friendly platform for the automation of manual tasks such as data entry, running the analyses, and processing results, while presenting them in a form that can maximize the efficiency of time spent by expert engineers in assessing the pay-offs and making design decisions." Langlois argues that the expert engineer cannot be replaced by the software; rather the software is used as a tool where less time is required by the users on manual processing tasks so that more time can be given to making the important decisions regarding pay-offs.

He also highlights the trend toward vehicle electrification, which he reveals is leading to higher speeds within transmissions and, therefore, higher and differing demands on transmission components. "With tighter integration between the electric motor and transmission, the coupling effects between the two need to be included," he comments. "The transmission is becoming the control center within the vehicle, taking and combining power from multiple sources and driving the wheels with less driver input."



The high-tech software allows engineers to design entire transmission and driveline systems using a comprehensive selection of components and design databases

As a result, transitions between power sources and ratios must be seamless and quiet to ensure driver comfort, which he says requires simulation of control systems alongside mechanical systems, increasing the demands on software in the design stages.

"Let's also not forget the continued trend toward higher-fidelity models and analyses," he says. "With the ever-increasing access to computing power, the opportunities for higher-fidelity analyses increase. Models that could not previously be run due to excessive memory requirements are now being run routinely. And as run times improve, analyses that once were run as a final check of a design can start to be used earlier and earlier in the design process when more design iterations are considered."

In the coming years, SMT plans to aid the industry as it moves further toward successful electrification, to achieve the stringent and ambitious emissions targets being set. Langlois adds, "We further aim to continue to provide automation and optimization solutions running more and more high-fidelity analysis models to increase the efficient utilization of engineers and provide the results they need to make effective engineering design decisions."

For example, scripting options within MASTA will enable the whole process of building models, modifying models, running analyses, and compiling results to be automated. Additionally, further scripting will enable users to write their own calculations to replace parts of SMT's calculations or to supplement SMT's calculations with a user's own, while maintaining their own IP.

"The transmission is becoming the control center within the vehicle, taking and combining power from multiple sources and driving the wheels with less driver input"

Dr Paul Langlois, software engineering director, SMT