

Transmissions in Transition

Randy Stott, Managing Editor

Experts gathered at the 9th CTI Symposium to discuss the challenges of reducing noise, improving energy efficiency and meeting the changing demands of the marketplace

Fuel efficiency is the hottest button among hot-button topics being discussed by automobile manufacturers and their suppliers today. Virtually every component in an automobile has been reengineered over the last decade to reduce vehicle weight, decrease energy consumption and recover energy otherwise lost. Nowhere is that more true than among those involved with designing and developing automobile transmissions, as evidenced by the presentations, discussions and exhibits at the 9th International CTI Symposium, held in May in Novi, MI.

Nearly every presenter at the symposium spoke about government regulations that require auto manufacturers to reduce the fuel consumption of their fleets by targeted deadlines. In the USA, the automakers have a deadline of 2025 to meet the Corporate Average Fuel Economy (CAFE) standards. Similar regulations are in place throughout the world.

Naturally, the transmission is a key component in achieving those standards, and the amount of reengineering that's already taken place and that continues to take place has made the design and development of automo-

bile transmissions far more complex than it used to be.

It used to be that engineers had to choose between manual and automatic, between three speeds or four. Today the discussion begins at six speeds and goes up from there. The practical limit seems to be in the 10-12 range, because every additional gear adds complexity to the device — think about the clutches and controls involved. Add in today's choices of dual-clutch transmissions, CVTs and electric motors — nearly everyone in the industry is talking about or beginning to implement some form of electrification of their transmissions — and you quickly begin to understand how much this industry has changed in recent years.

Add to that the much more rapid development cycles required by today's market for new transmission models. The lifetime of a manufacturing line for transmissions is no longer the 20 years it used to be. Today, it's more like five or six years.

All of this just explains how important conferences like the CTI Symposium are, and why the CTI Symposium continues to grow. The 2015 USA conference included more than 500 participants, more than 60 technical presentations, and 39 exhibitors. This compares with 400 participants, 47 presentations and 29 exhibitors at last year's conference. CTI holds three conferences each year: one in the USA,

one in Asia and one in Germany. The upcoming 2015 conferences will take place in Shanghai (Sept. 16-18) and Berlin (Dec. 7-10), with Berlin being by far the largest of the three (last year's Berlin conference had more than 1,300 participants).

Whether or not you are directly involved in the auto industry, it pays to take note of what's going on there, because inevitably, much of the technology developed there finds its way into other industries.

The conference included two days of plenary speeches and technical presentations. Plenary speeches included:

- Welcome address and opening comments, by Ernie J. DeVincent, vice president, product development for Getrag and chairman of the conference.
- "The Getrag Approach to Enabling Global Fuel Economy Compliance," by John McDonald, chief operating officer for Getrag global operations.
- "GM's Perspective on the Evolution of the Automotive Transmission 2020 and Beyond," by Mike Harpster, director of GM's Propulsion Systems Research Lab.
- "Enablers for the Next Generation of Fuel Economy Regulations," by Don Hillebrand, director of the Center for Transportation Research at Argonne National Laboratory.
- "Efficient Future Mobility – the Road to CAFE 2025," by Philip George, director of advanced development for Schaeffler North America.
- "Can We Make That?" by Charles Gray, director of transmission & driveline engineering for Ford Motor Co.
- "Contribution to World Market by CVT Technologies," by Hiroyuki Kai, director general of JATCO Mexico.
- "Future Proofing Our Waste and Delivery Transit Infrastructure," by Ian Wright, CEO of Wrightspeed Inc.
- "Roadmap to Autonomous Driving," by Ali Maleki, vice president of business development for Ricardo Inc.

More than 500 engineers and other industry professionals gathered at the 9th CTI Symposium held in May in Novi, MI.



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In addition, technical presentations were given over the two days in the following topic areas:

- Transmission Concepts
- Drive Cycles
- Hybrid Electric Vehicles
- Diagnosis and Functional Safety
- All-Wheel Drive
- Noise, Vibration and Harshness
- Manufacturing/Transmission Components

During coffee breaks, during lunch, and between sessions, visitors had the opportunity to talk with the exhibitors in a table-top exhibit hall, where suppliers to the industry discussed their latest innovations. A number of key suppliers of materials, software, mechanical power transmission components and complete systems were a significant part of the exhibition.

Alex Tylee-Birdsall (right), technical director of Drive System Design, explains the company's prototype transmission project to a visitor at the CTI Symposium.

Gear and Transmission Expertise on Two Continents

Drive System Design is a company specializing in the design and development of transmission, driveline and gear drives, says technical director Alex Tylee-Birdsall.

"If you look outside of automotive, we also work in off-highway, industrial transmissions — really gear drives and anything that transmits power."

Drive System Design was founded in 2007 with a staff of two. Over the years, it has grown to more than 60 people, and in 2014, the company opened a dedicated office in Farmington Hills, MI, to serve the North American market.

"We've gained a reputation for really good engineering, being right on the cutting edge of what people are doing, and analytically solving problems very quickly — like NVH issues," Tylee-Birdsall says. "We've tried to get



the best engineers we possibly can in both markets. I would argue that both in the U.K. and over here we've built up the best teams of those people. I think that's one of the reasons why people come to us."

Drive System Design works on a wide variety of projects, Tylee-Birdsall says. "It can be anything from a really



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small project — just design a gear — up to a full three-year transmission design and development program, all the way up to production.

“One of the smallest transmissions we ever worked on was for a mechanical hand. The transmission measured 28 mm in diameter by 10 mm in length. It was a two-speed, torque-sensing transmission. Effectively the way that worked is that if you go to grip some-

thing, it moves very quickly. Once it senses resistance and pressure, then it moves much more slowly to grip.”

The company has also done significant work in off-highway markets.

“That’s a developing sort of marketplace,” Tylee-Birdsall says. “People want to have better shift quality, and they want to be comfortable in their air-conditioned cabs, whereas back in the day they were quite happy with the sun beating down on them. We’re seeing a lot of opportunity there in developing the control systems to make shifting better.”

“We also have major projects in oil and gas,” Tylee-Birdsall says. “There are quite a lot of innovative people out there looking at ways of extracting oil, and all of that stuff needs power transmission. It needs reliable gearboxes. If you take fracking, for example, there’s a lot of use of conventional transmissions in that industry. They’re having



Philip George

to run at quite high power for a long time, and they’re not really designed for that. So there are a lot of people looking at proper transmissions designed just for that.”

And optimizing transmissions and the related systems is what Drive System Design specializes in. The company uses a combination of software and engineering expertise to provide solutions to customer problems.

“We’re often using the ability of MASTA to develop transmission housings while still on the drawing board,” says Shaun Mephram, president of Drive System Design, Inc., the USA



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branch of the company. "That allows us to engineer the housing structure such that it is quieter than what we used to do by engineering it from scratch, not doing any analysis and waiting for it to be measured on the test rig. We are computing all of the losses in all of the components, then constructing the loss of a gearbox and comparing it against three, four, five other variants, to make sure that the one that comes off the drawing board is the solution with the lowest loss."

Tylee-Birdsall adds that the company's engineers aren't restricted to any one piece of software or tool set. They rely heavily on a wide variety of software, including very specific packages such as Klingelnberg's *KIMOS* and Gleason's *CAGE* software. They also work in a wide variety of CAD and FEA systems so that they can communicate designs with customers no matter what platform they use.



Of course, the company's display at the CTI Symposium focuses specifically on automotive. One of the centerpieces of their display was a prototype transmission that the company designed, developed and produced as a demonstration of their capabilities.

"We're a consultancy, so that means that a lot of what we do, we can't talk about," Tylee-Birdsall says. "We've signed NDAs, that sort of

thing. So one of the things we decided to do about four years ago was to do our own research project." In this case, the project involved a new way of adding electric motors to the driveline. "We looked at what everybody was doing," Tylee-Birdsall says. "What we saw was, everyone was doing single-speed gearboxes and using very energy-hungry high-speed motors. And we thought, 'We're transmission engineers. We can do better than that.'"

So Drive System Design developed an architecture that includes 48V electric motors that can be easily fitted into the drivetrain and deliver extra power where needed — without the complexity, expense and need for recharging stations required by higher voltage systems. They also reduced the energy consumption of the transmission by going multi-speed.

"It's not necessarily a product that we're selling to market," Tylee-Birdsall says, "but it gives a showcase that says,

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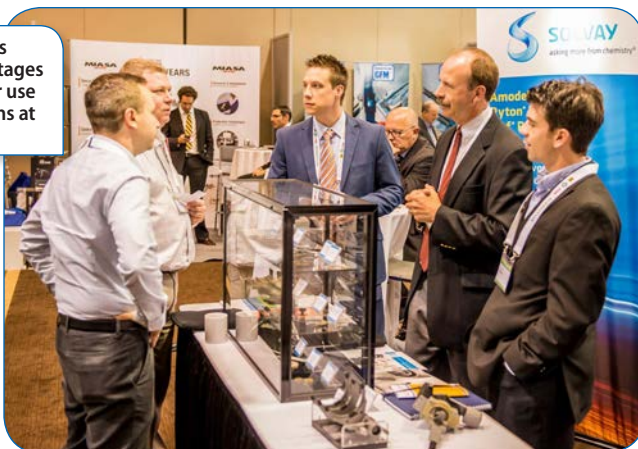
Solvay Specialty Polymers demonstrated the advantages of engineered plastics for use in automotive applications at the 9th CTI Symposium.

look, we can do a full transmission design in a vehicle. We can do the control system, the hydraulics. It gives a good showcase of everything we can do. It's got all of our gear design technology in it as well.

We've done an awful lot of work in low-noise gear design. In fact, a lot of the major electric vehicle manufacturers have our gear designs in them."

Tylee-Birdsall emphasizes that the company is far more than just a design consultancy.

"Along with the ability to design, do detailed analysis and write control systems, we also have a full facility in the



Hiroyuki Kai

back that allows us to do full prototype assembly. We have vehicle ramps that allow us to do vehicle build and installation. We have six test cells, including spin rigs, lubrication tilt rig, a fully loaded 310 kW loaded rig. And we have a massive four-square rig, and our own hydraulics clean room."

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Plastic Components Simplify Design, Save Space and Weight

At the Solvay Specialty Polymers booth, the emphasis was on replacing

traditional metal components and systems with plastics.

"One of the main applications we're focused on is needle bearing replacement," says Brian Baleno, global automotive manager for specialty polymers. "A typical needle bearing is quite complex. With a polymeric bearing, there are several benefits. One is weight savings. But the biggest benefit is space savings."

In a typical automotive needle bearing application, you can get an average of 2mm space savings. "That allows you to downsize the transmission casing or housing," Baleno says. "That means weight savings, which translates into less energy consumption."

The technology also can be used outside of automotive, in industrial applications, Baleno says.

"Anywhere you want to realize weight savings and also improve efficiency. The nice thing about a polymeric thrust bearing is that you can design in an oil groove, so you can get oil to flow through and provide continuous lubrication as well."

"Another application that we do a lot of work on is seal rings," Baleno says, adding that today's highly engineered thermoplastic materials are better able to withstand the high temperatures and pressures required by many automotive applications. **PTE**

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