

How Will We Fuel the Future?

CTI Symposium 2022 addresses our path toward electrification

Matthew Jaster, Senior Editor

My first trip to the CTI Symposium USA six years ago was eye-opening regarding the ambitious forecasts for electrification in the automotive industry. Hybrid transmissions took center stage back then with a hint at a fully electric future on the horizon. Individual components were showcased in the expo hall as well as the technology sessions. Optimism for self-driving vehicles, e-mobility and the switch from ICE to electric vehicles was somewhat restrained.

Today, the future of EV and HEV drives and components looks much more attainable. Individual components are now being replaced by systems being coordinated by software in

a new digital microcosm. GM is committed to an all-electric future. So is Ford, Stellantis, Volkswagen, Toyota and any other automotive company that wishes to remain relevant in 20 years. The latest CTI Symposium confirmed this electric journey.

According to Dr. Hamid Vahabzadeh, chairman, CTI Symposium USA and strategy advisor, AVL GmbH, the CTI Advisory Board has been focusing on the leading-edge technologies and providing a forum for the industry to debate and discuss the latest technologies needed for the next generation of vehicles.

CTI started about 20 years ago as a transmission and driveline technology symposium. Initially, the focus was on

conventional automatics and manual transmissions. Over the years, this coverage expanded to DCTs, CVTs, and a wide variety of advanced and novel transmission concepts. Most recently, as the industry began the pivot to electrification, he said the industry shifted focus to hybrids and covered a wide range of hybrid concepts including modular (add-on) hybrids as well as dedicated hybrids.

“Now we see a clear transition to Battery Electric Vehicles (BEV) for light duty and passenger car applications and potentially fuel cell technologies for medium and heavy-duty applications. Therefore, our ambition is to stay on top of the trends, and focus our content, papers, speakers to capture the industry



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challenges in this area and invite speakers that are working on advanced BEV systems and sub-system technologies including; new batteries, e-motors, e-axes, power electronics and grid integration. Facilitating the debates via panel discussions to prep the engineering community on how quickly changes are coming,” Vahabzadeh said.

An Electric Mindset

The EV market has been growing steadily over the last few years. The legislation and scale of EV is real now. This was not always the case.

“Five to 10 years ago, the feeling wasn’t as certain, but now it is inevitable. The unknown is how quickly supply chains can be enabled to support

the full pivot to BEV. Many OEMs have announced their plans to convert their products to pure electric drives. The timing may not be as fast as everyone states. It may take a bit longer to make it a reality based on the need to mine the critical materials and then put the capital in the ground to process the minerals that are needed for all these batteries,” Vahabzadeh said.

The automotive industry has faced several challenges and very tough regulations in the past. They have shown to be very resilient and creative in meeting new regulations by developing and implementing new technologies, managing their fleet mix, and purchasing or trading credits with other OEMs, and occasionally, paying

penalties. The 2030 regulatory targets are not any different. While they are very challenging, Vahabzadeh said will be met one way or another.

When it comes to BEVs, Vahabzadeh said consumers are mainly concerned about their total ownership cost and practicality of their selection. There has been a significant effort and development aimed at improving the energy density and cost of batteries resulting in a noticeable reduction in the total cost of the battery packs, and consequently, the electric vehicle prices. “This has also improved the operating range for the BEV which is another major concern for the average consumer. However, these improvements are not sufficient and need to



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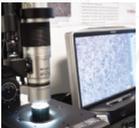
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continue on the same path to make the BEV affordability a reality for the average consumer. Another big factor is the infrastructure and availability of fast charging stations to ease the range anxiety that some consumers may have."

There's enough information out there regarding our global path toward electrification that consumers are a lot more educated and smarter these days. Vahabzadeh said that the green aspect of these vehicle has played a major role in considering an electric vehicle.

"They are fantastic to drive. As consumers get into them, they will love them. They like the vehicle performance and smoothness. The ride and handling of BEVs are impressive. This

and is always addressing the most relevant questions, delivering viable solutions and proposals for future mobility options. The intensive cooperation with the advisory boards in each region provides the latest information for the entire automotive community.

The programs are a mixture of topics which are relevant for each region and meeting regional specific questions. The markets and regulations are not developing 100 percent parallel in terms of surrounding conditions, political framework and customer choice. The CTI events share viewpoints, findings and strategies and address local questions. For example, BEV systems are currently the focus here in the United States whereas CTI

This year's U.S. Symposium offered new concepts and technologies being developed by different companies to enhance the current state-of-the-art of the BEV. Executives in charge of the leading OEMs and suppliers discussed their strategies for meeting the consumer expectations in cost, quality and performance while trying to meet strict regulations. Vahabzadeh enjoyed hearing how the different companies feel about the pivot to BEV. Will it happen as quickly as their stated goals or will we continue to see an overlap of traditional drivetrains, hybrids, and BEVs for a protracted period of time?

Questions Moving Forward

The future of EV markets in each region are mainly driven by the legislations, government incentives, and regulations. China and Europe are leading in implementing BEVs with US market following. While the China market is converting to BEV, it is also entertaining the plug-in hybrid option.

Vahabzadeh does not foresee a significant change of topics in the near future. Electrification will continue to be the focus for upcoming programs.

"As more and more BEVs enter the market, sufficient electric power generation and efficient distribution infrastructure will be more prevalent. New battery technologies and more efficient e-motor technologies will be discussed," Vahabzadeh said. "Vehicle affordability for the average consumer and new business models and purchasing/leasing options will be discussed. Continued supply chain constraints, and raw materials availability will be of concern. How will OEMs evolve and vertically integrate with BEVs? Will they continue to outsource areas, or bring those in house and consider them core to their experience?" **PTE**

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is due to their low center of gravity and people have noticed this and like it very much. But I am not sure everyone loves the price today," he added.

The Evolution of CTI Symposium

CTI Symposium has been taking place for two decades. What started as a transmission conference, turned into a hybrid drivetrain forum, and has transformed into an electric drivetrain conference. It's an opportunity for attendees to recognize trends and strategy changes early, paying close attention to technological developments and regulatory influences. Thus, CTI was

Symposium-Germany is looking at fuel cell electric vehicles (FCEVs).

"With our events we want to connect the biggest automotive markets and regions where the engineering work happens. Regions and markets have their commonalities but also differences in terms of regulations, government incentives, political surrounding conditions, customer expectations, vehicle usage, etc. To support the exchange of opinions, viewpoints, strategies and engineering developments, CTI has created a 'World Series' bringing companies and experts from all over the world together within each region," Vahabzadeh said.

Topics at CTI Symposium USA

Here's a small sample of the technologies discussed during the CTI Symposium 2022 in Novi, Mich.

Thermal Management for EVs

Energy is a precious commodity in electric vehicles. Using sophisticated thermal management, designers can extend vehicle range at a stroke by reducing the power needed for optimal temp control of interiors and batteries. High-performance thermal management is also a must for fast charging – and the performance, operational reliability and service life of various system components all depend on a functional thermal management setup. At CTI, topics in the field of thermal management included thermal analysis tools for EDUs, a central coolant control module, and highly effective immersive cooling.

When checking EDU subsystems and components for smooth operation or dangerous hot spots, today's designers have various tools at their disposal. But as Michael Furness, Drive System Design, USA, explained, "With this kind of silo-based design approach, you risk overlooking crucial thermal interactions at the system level."

The Thermal Analysis Tool developed at Drive System Design accesses existing subsystem datasets to quickly generate a system-level thermal model of the design. The tool has been automated to ensure fast modeling. It can be used cost-effectively at every stage of the EDU development cycle and can help to inform design decisions on every level.

By running a system-level thermal analysis early on, designers can reduce the likelihood of costly changes further downstream. The short simulation cycle significantly reduces development time and supports designers without the need to parameterize and apply costly FEA programs. Thanks to the tool's modular implementation of heat transfer physics, designers can use simple empirical equations at an early design phase to obtain a rough understanding quickly. When more mature analyses become available, they can be fed into the tool to improve accuracy.

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Small Electric Motor Improvements

As all designers of electric motors know, seemingly small improvements can yield tangible benefits. In his presentation, DeeDee Smith (Solvay Materials, USA) discussed optimizing the insulation materials used in electric motors.

Specifically, the issue concerns the slot liners that shield the stator core from the winding. As OEMs progressively migrate from 400-volt systems to 800 volts or higher, it's becoming clear that traditional paper/paper laminate insulation is no longer ideal. To address that issue, Solvay has been working with e-motor designers to evaluate the suitability of Ajedium PEEK slot liners as a new

high-voltage, high-temperature solution. As their findings show, Ajedium PEEK slot liners are an advanced alternative that combines excellent electrical and mechanical performance with greatly reduced thickness. In some cases, volumes can be reduced by up to one third, compared to established solutions.

Engineers can exploit this advantage to increase the motor's power density, either by making the e-motor more compact or by using the free space in a way that enhances performance. The thermoplastic PEEK film is temp-resistant to 240°C and offers improved thermal conductivity—more than three times that of current paper and paper laminate materials. This in turn helps to reduce overall motor temperature.

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High-Speed Traction Motor Production

How do you produce rotor and stator cores for traction motors at high speeds and volumes, at low costs and in perfect quality? In his presentation, Max Thieme (Schuler Pressen, Germany) examined the optimal solution for this challenging task.

First, the speaker presented and compare the basic methods for stamping sheet metal for electric motors. He focused on ultra-modern bonding techniques such as interlocking, gluing and bonding varnish/Backlack, all of which can be used to combine metal sheets into a complete package. Bonding varnish in particular offers convincing benefits. Unlike interlocking and welding, this process rules out short circuits between individual sheets. As a full-area bonding method, it also outperforms gluing – no liquid can penetrate, and thermal conductivity and NVH behavior are both better.

Finally, Thieme explained why progressive dies are suitable to produce traction motor stacks in typical quantities and sizes. This method kills two birds with one stone: high speed stamping, and high-quality bonding. To eliminate the downside of handling separate sheets, a fully automated system collects sheets below the progressive die and brings them to the gluing stations in a controlled and secure manner. These gluing stations are freestanding units that offer full control over all process parameters such as pressure, temperature and time. The solution is usually offered as a turnkey system that covers everything from winding off the raw material to the finished laminate stacks. That said, retrofits for existing machines are also available. **PTE**

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