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ENLIGHTEN AWARDS: MOST WEIGHT REDUCTION IS POWERTRAIN AGNOSTIC

Weight efficiency benefits for ICE, EVs and hybrids

Perhaps the most well-known automotive award for vehicle-weight reduction, referred to as lightweighting, is the Enlighten Award, presented by Altair. This award is given each summer at the Management Briefing Seminars (MBS), hosted by the CAR (Center for Automotive Research) Group.

This past summer, I got a chance to attend the MBS meetings for the first time, and it left a lasting impression. Traverse City, Mich., is always a great place to visit. Yet much more than that, the networking at MBS was

really good. The attendance is broadly covering automotive, yet in my world of lightweighting, it was target rich. I suspect that the Altair Enlighten award ceremony helped bring in people dedicated to lightweighting.

Nearly every day, we hear conversation on electric vehicles, often compared to internal combustion engine (ICE) vehicles. Weight efficiency is a benefit with either powertrain, yet it is certainly appreciated more with EVs due to the range limitations in the power source and the limitations in

the charging infrastructure. Are there parallels between the 2018 Enlighten winners and vehicle powertrain?

The commentary by the winners was definitely neutral to the powertrain source—examples:

“Vehicle weight is the most important challenge.”

“Lightweighting is a piece of sustainable mobility.”

◀ AWARD WINNERS ▶

CATEGORY	WINNER	SOLUTION
Enabling Technology	Sika U.S. Steel Corporation Asahi Kasei	Noise-damping material Stronger steel Pedal bracket
Module	BMW	3-D printed bracket for i8
Module Runner-Up	Faurecia	Exhaust pipe material
Future of Lightweighting	American Axle Manufacturing (AAM)	Gearboxes
Full Vehicle	General Motors	'19 Silverado, steel body
Full Vehicle Runner-Up	Daimler Mercedes	'16 Mercedes-AMG, carbon body

Taking a closer look at the award winners through the lens of the powertrain, the most obvious fit for the IC engine is the exhaust-pipe material that would deliver 3 to 5 kgs of weight savings. The gearbox from AAM is likely targeting IC engine vehicles in this application. Yet the key improvement is the increased power density, mostly enabled by design efficiency, and time, and they will translate to their electrified product line.

The remainder of the award winners are powertrain agnostic, applicable for EVs, ICEs or hybrids—and perhaps more valuable for one powerplant than another:

Sika’s noise-damping material, described as an ultra-lightweight constrained layer material system for structure-borne noise, may be more useful for EVs because the engine and exhaust system noise no longer masks road noise. Customers appreciate a quiet cabin, as noted at the Lightweighting World Expo in October 2018, where Keynote Speaker Lyndon Lie spoke of the design target for the Cadillac CT6 as “bank vault quiet.” The challenge for vehicle producers is one of noise reduction relative to weight and cost. The Sika innovation is aiming to solve that problem with an effective, lightweight material replacement.

U.S. Steel Corporation’s Mar-Ten™ 1500, martensitic steel delivers a whopping 1500 Mpa tensile strength, yet can still be formed and processed to body-structure applications. Advanced high-strength steels will continue to replace lower grades,

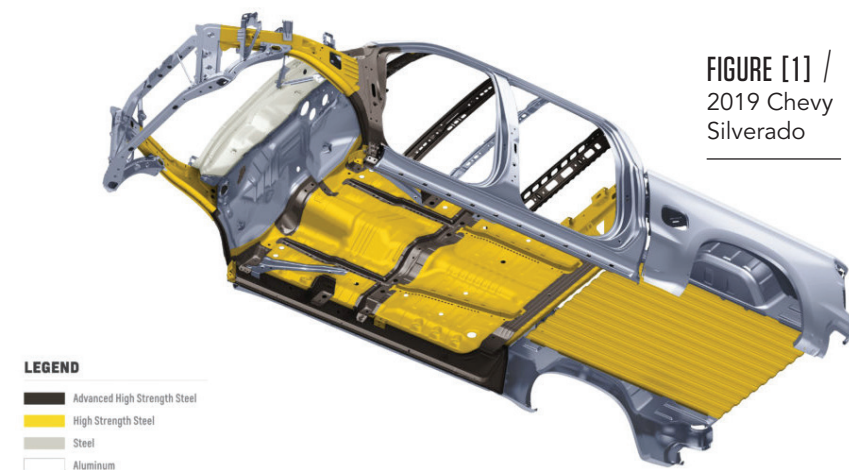


FIGURE [1] /
2019 Chevy
Silverado

LEGEND
 ■ Advanced High Strength Steel
 ■ High Strength Steel
 ■ Steel
 □ Aluminum



FIGURE [2] /
Optimization, left to right,
of the BMW i8 Roadster roof bracket

providing economical weight savings for years to come.

GM’s award-winning 2019 Chevy Silverado pickup truck was designed with extensive use of advanced high-strength steels and cut an impressive 450 pounds (204 kg). (See Figure 1.) Reliable fastening and joining is critical to the long-term durability of a vehicle body, and because GM was able to keep most of the body within the ferrous material family of alloys, there was little change to the integration strategy, tooling and welding recipes. The weight reduction leads to improved towing, fuel efficiency and vehicle handling.

BMW was recognized for using 3-D printing, also referred to as additive

manufacturing (AM). In this case, it is metal AM. (See Figure 2.) Additive manufacturing represents the ideal lightweighting technology because a component can be designed with optimizing software, and the AM process is one that will produce that design closest to the model from the software. By comparison, if the part were to be made into a casting, a foundry designer would need to add draft and more consistent wall thicknesses. The added mass diminishes the weight benefit of a CAE (computer-aided engineering)-optimized model. The award winner said, “In additive, cost is linked to volume. The lighter you make it, the cheaper it gets.”

According to the article, “The Ultimate Printing Machine—How BMW

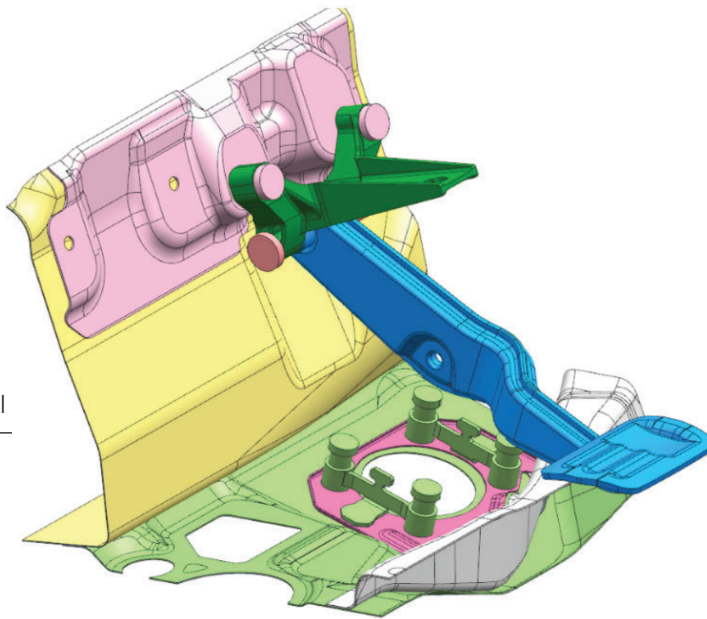


FIGURE [3] / Polymeric pedal

is applying 3D printing to commercial vehicles” in TCT Magazine, BMW delivered a 44-percent weight reduction and improved stiffness 10 times more than the counterpart made of plastic. Now, this is an aluminum component, using AlSi10Mg. How often do you see a plastic converted to aluminum? Almost never. BMW developed this mechanism for the i8 Roadster convertible roof and qualified it for production with this new alloy and process. The process uses metal powder in a selective laser melting process.

Asahi Kasei used its engineering tools and material-design capabilities to test and develop a pedal, for the brake or the accelerator, yet was able to reduce the system weight by 80 percent from a metal stamping. Coming from a traditional steel-stamped design, they selected a glass-filled polyamide 66 at a significantly lower density, yet still meeting the application requirements. (See Figure 3.)

The weight savings is large by comparison to the incumbent pedal. Yet because a brake or acceleration pedal is a safety-critical component, I expect

it will take a long time to gain mass-market acceptance.

The Full Vehicle Runner-Up was awarded to the 2016 Mercedes AMG GT R, noted for the use of carbon fiber composites to reduce vehicle weight by 33 percent over the previous model. It wasn’t all carbon fiber. The chassis is an aluminum space frame, and in the wheel wells, AMG used “old school fiberglass” with a cork layer in the middle.

Most of the Enlighten Award winners will find applications on light-duty vehicles powered by internal combustion engines, or powered by batteries and electric motors. This is good news because the market acceptance of EVs is uncertain, and for new technology to proliferate, the developers need high sales to get the return on investment.

There are many challenges in the development and scale-up of new materials. At times, OEMs sometimes choose to do the work in-house to avoid the typical supplier-OEM system of competitive suppliers able to deliver a common product at a

competitive price. My guess is that the additive manufactured components on vehicles today are either developed in-house or are developed with limited exposure to the supply base. Eventually, the supply chain will be robust enough to support AM in automotive. There is certainly considerable effort to get there. **LW**

ABOUT THE AUTHOR:

Andrew Halonen provides strategic marketing, sales and business development services for technology-based clients in transportation markets, with a focus on weight reduction. He earned a BSME degree from Michigan Tech University. While at college, he interned at Ford Motor Company and 3M, and then went to work at 3M full time doing machine design, application engineering and market research. Mr. Halonen spent six years in business development at GS Engineering in advanced materials. He started Mayflower Consulting in 2009 and is active in castings, composites, new alloy developments and additive manufacturing in automotive, defense and commercial trucking. www.lightweighting.co.

