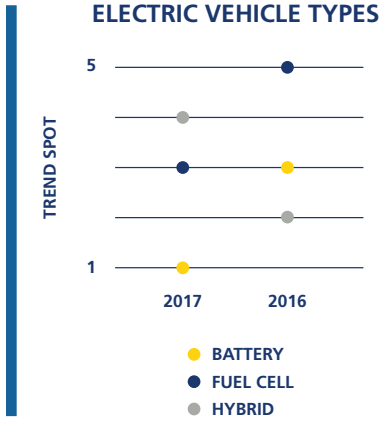
STANLEY
Engineered Fastening

Electric Vehicles

How new players – and ideas –
are driving electric vehicle production.

Leaders in the global automotive industry believe their future is electric.

Among almost 1,000 industry decision-makers surveyed in Europe, Asia and the Americas, 50 percent believe battery electric vehicles are the No.1 trend in the automotive sector. This is up from the No.3 spot in 2016 (and up from the No.9 spot in 2015), according to *KPMG's Global Automotive Executive Survey* 2017.



Fuel cell electric vehicles were ranked as the No. 3 trend in the current survey (up from No. 5 in 2016), at 47 percent; and hybrid electric vehicles were No. 4 (down from No. 2 in 2016), at 44 percent.

Influencing opinions are stricter overall miles-per-gallon regulations, lower battery costs, an expanding battery charging infrastructure, developments in autonomous driving, and increasing public acceptance of electrified vehicles, including hybrids, plug-ins, battery electrics, and fuel cells.

Government policies are also pushing public acceptance: For example, in 2017, the United Kingdom's government reaffirmed its commitment to electric cars, saying that sales of conventional gasoline and diesel vehicles in the four-country nation will end by 2040, according to an article in Torque Expo.[1]

EVs usher tech sector entrepreneurs into vehicle industry
The makeup of the decision makers who lead the automotive industry, including those contacted by the KPMG survey, is also changing, because new leaders in the vehicle manufacturing sector are emerging from the tech sector and elsewhere.

It's not just entrepreneurs who are expanding into automaking though. Chinese ride-hailing company Didi Chuxing is partnering with 31 automotive partners to produce its own fleet of cars.

Among respondents to the KPMG survey, 82 percent of executives absolutely or partly agree that a Silicon Valley company will launch a car in the next four years. And 78 percent absolutely or partly agree that a car from a Silicon Valley player will be assembled by one of the traditional OEMs.

"In the past we were talking to GM, Ford, Daimler, BMW, companies who built cars for more than 100 years, so they knew what to do," says Rupert Becker, Director of Global Product Line Management - Automotive for STANLEY Engineered Fastening in Linden, Germany. "All of a sudden, we have internet billionaires, and they have the idea of building a car. It's a big education process and one of our biggest challenges, but also a big opportunity."

PayPal co-founder Elon Musk may be the most prominent Silicon Valley executive to enter into the EV business, and his experience points to both sides of the challenge-opportunity equation. On the opportunity side, his automotive company, Tesla, seemed to function well when its output volume of the Model X sport utility vehicle, Model S sedan or premium Model 3 was small. But big challenges now face the automaker, which had to re-work their automated production facility when efforts to ramp up production of the Model 3 were repeatedly unsuccessful.

While Musk's company is in the United States, internet billionaires intent on producing cars literally come from all around the globe.

"Our customer Nio, a global company founded in China, is one of the companies starting from scratch, never built a car before, and they're open to everything at the moment," Becker says "They're mixing materials even more than Audi or BMW these days. And they have no experience, so they're open to trying things."

William Bin Li, Nio's founder, began building his fortune by founding Bit Auto, a web-based auto sales platform that also includes mass media and advertising. He was also part was part of the original team at DangDang, China's version of online retailer Amazon.

It's not just entrepreneurs who are expanding into automaking though. Chinese ride-hailing company Didi Chuxing is partnering with 31 automotive partners to produce its own fleet of cars. In turn, Didi is offering its customer development and operational expertise to car companies who want to develop their own Uber-like services.

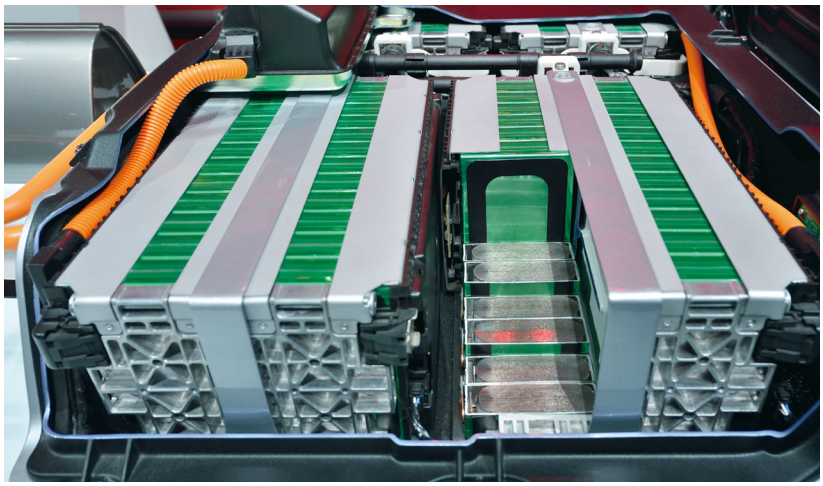
In Germany, the logistics company Deutsche Post DHL Group decided to use its StreetScooter offshoot to build its own electric delivery vans, e-bikes and e-trikes. StreetScooter partnered with Ford Motor Company to make the vans, which are based on a Ford Transit chassis fitted with a battery- electric drivetrain and a body designed to Deutsche Post DHL Group specifications. The no-frills vehicles are available for sale to municipalities and small businesses.

Advances in manufacturing software – and actions taken by the traditional vehicle makers themselves – have made it possible for newcomers such as Tesla, Nio, Didi and Deutsche Post to enter the vehicle manufacturing industry, according to ***Automotive News.***[2]

The trade newspaper provides additional context: These developments are enabling companies to "tap suppliers to design, engineer, and test new vehicle concepts without hiring thousands of engineering staff or investing billions in tooling and factories."

Also, as ***Automotive News*** points out, technical and engineering know-how among vehicle suppliers has blossomed since traditional manufacturers began farming out R&D to keep their own costs down after 2008's global financial crisis.

As a result, suppliers – rather than car companies themselves – produce components which make up 80 percent of a car, up from about 56 percent in the 1980s, creating a manufacturing system which is being used by new entrants.



As the transportation business model evolves, so do the design, engineering and the inner workings of EVs — all while considering the vehicle's weight.

As for why making automobiles is so tantalizing for tech entrepreneurs and other newcomers? No study exists, but observers have noted that vehicles are no longer meant just for transportation, but are technology on wheels. The new, evolving technologies in EVs and autonomous vehicles are ripe for the entrepreneurial mindset. In most cases,, entrepreneurs are nimble business people not tied down with a huge infrastructure like the traditional OEMs.

EV tech evolving with weight in mind

As the transportation business model evolves, so do the design, engineering and inner workings of EVs – all while considering the vehicle's weight.

"I think this is a fast-changing market at the moment," says Becker. "The EV you bought three years ago is already out of date in terms of technology."

The major driver for the evolution of EVs is battery technology. Current car battery technology is dependent on rare earth materials mined from a very few countries that are politically unstable, which threatens the supply chain. This makes alternative battery technology very desirable.

Also, bright minds are focused on reducing battery weight and size. The battery powering an EV weighs an estimated 220-661 pounds (100-300 kilograms). Fasteners for those batteries provide a weight-loss opportunity.

"Metal brackets are used inside the battery box to hold individual batteries in place, but they could be made out of plastic," says Wolfgang Lange, European Business Unit Director Tier for STANLEY Engineered Fastening. "Toyota does this."

In fact, smart people in all automotive companies think about reducing the weight not just of batteries, but of the entire wire harness system. That's because the wire harness has become so complex that it's the third-heaviest component in a vehicle. Only the chassis and engine weigh more.

"It should not change a lot if it's a combustion engine or an electric vehicle," Rupert says of the harness. "You still have all the navigation, radar, sensors, and maybe even more sensors for autonomous driving."

So, changes in the wire harness would help with light weighting virtually any vehicle but it's a particularly important factor for EVs. Every pound or kilogram trimmed from a vehicle's weight means more miles or kilometers on a charge. That may not be so important for city driving, where a home or commercial charging station is conveniently nearby, but it's a must for long-distance transportation.

Becker says, "In Europe, they're focusing on longer-distance cars. VW will have a small one, but they'll also have SUVs, a bus, a sedan. When Porsche starts this, they'll want a couple hundred kilometers from the start. Nobody wants to buy a Porsche with the range of 250-300 kilometers (155-186 miles). And light weighting is one of the keys to it."

Staying grounded in electrical function, safety

In addition to light weighting, providing better solutions for electrical grounding has become more critical in EVs and autonomous vehicles.

Grounding is important because electric current won't flow unless it has a path to return to its source. In most systems, the current flows

from the positive post on a battery to the device needing power, and eventually back to the battery's negative terminal via the car's metal components and frame.

In older vehicles with metal frames and steel bodies, components were bolted together with very little insulating material separating them, so there were adequate paths to ground. Also, there were fewer accessories that needed electric power. Becker recalls that in his first car, he had lights, a radio, and windshield wipers. Little else was powered by electricity.

In new vehicles, however, there is much more insulation between components, and the chassis and bodies are made of a combination of conductive, poorly conductive and non-conductive materials. In addition, consumers want more and more accessories that require electric power. These changes make grounding both more challenging and, in many cases, far more important.

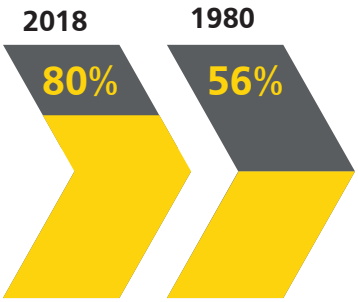
"When your lightbulb in the interior doesn't work anymore, it's not nice, but you will survive," says Becker. "When your electricity for the EV is malfunctioning, or your radar in an autonomous vehicle doesn't work all of a sudden, what will happen then?"

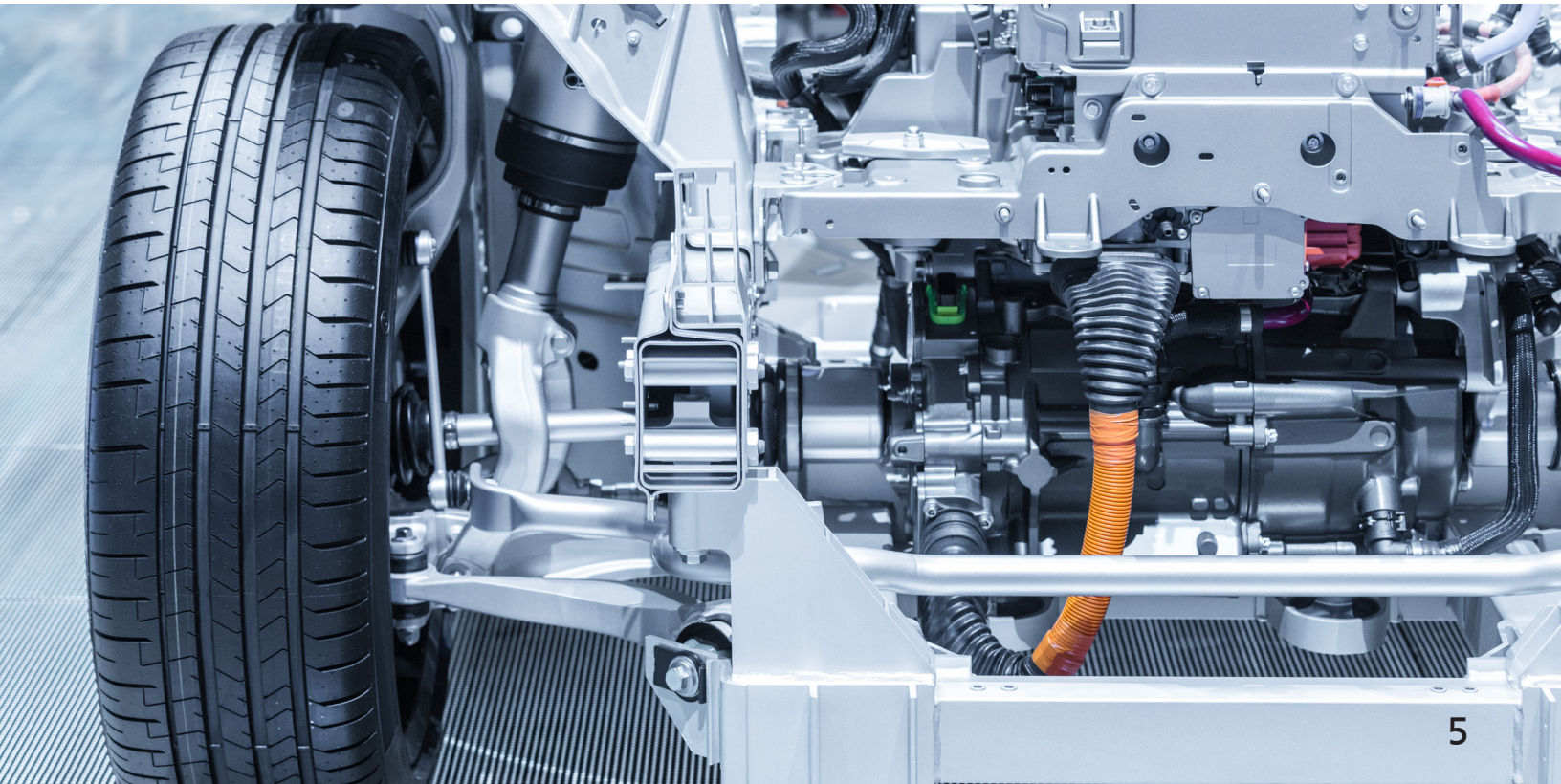
STANLEY Engineered Fastening developed a solution in the 1970s, a special grounding stud that it first supplied for the VW Golf. Today's cars have 50-plus of these grounding studs, and the company remains on top of the trend.

"We may be the leaders in grounding for high end, premium cars," says Becker. "Daimler, Audi, BMW, Land Rover, Jaguar and also Tesla use our grounding studs."

STANLEY Engineered Fastening is also concerned about electrical safety because of the high voltages modern vehicles use. To make parts compatible with the higher jolts of electricity, STANLEY invested in new technology to work with new material grades, such as thermoplastic polyphenylene sulfide, also known as PPS.

Produced Car Components by Suppliers





PPS – and PPS with glass fibers embedded in it to make it more rigid – have attributes that make it useful in applications subject to extreme conditions, such as aerospace and high voltage, according to an article in *Composites World*.[3] PPS has a melting point of 536-554°F (280-290°C), is inherently flame resistant, resists chemicals and oils, has high hardness and stiffness, and works with many manufacturing methods. As a thermoplastic, the material can be reprocessed, has almost no shelf-life limits, and requires no autoclave curing like other composites.

"When it comes to high voltage, you need special parts perhaps made in special colors (e.g., orange means high voltage)," says Becker. "We have those for battery packs and for fuel cell applications, made in a joint venture with two OEMs for parts. One for a fuel cell application, which would apply to EVs; the other for parts for a battery manufacturer, which would also be tied to EVs."

Jumping the battery charging hurdle

New battery technology aside, proponents of EVs are building a battery recharging infrastructure and brainstorming ways to work around the one to four-hour time delay necessary to recharge the battery in a Chevrolet Volt or Nissan Leaf.

Any EV can use a 240-volt, Level 2 charger found at hotels and public parking lots, according to an article in *Popular Mechanics*.[4] But things get more complicated when you need a 480-volt fast charge because not everyone agrees on a standard plug.

Tesla has set up a network of more than 1,000 Supercharger Stations in the Americas, Asia, Europe, and the Middle East that promise a full charge in 30 minutes. Nissan, Mitsubishi, and Toyota vehicles use the CHAdeMO network of 1,780 charging stations in the United States. BMW, GM, Ford, Volkswagen, Jaguar, and Honda cars use the J1772 Combo network.

Automakers BMW, Ford, Mercedes, and Volkswagen have banded together to create Ionity, an ultra-fast electric car charging network in Europe.

Their plan is to establish 400 stations across Europe by 2020. And Telekom, a European telecommunications company, plans to convert 12,000 of its distribution boxes in Germany to charging stations. Five hundred of them will be fast-charging. And Porsche plans an 800-volt charger at dealers in the United States in 2019.

The industry is also considering another approach: EV owners buying their own cars but renting the batteries necessary to operate them.

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"That is the biggest discussion now, to rent your battery instead of buying it," says Lange. "Instead of charging your battery, you would stop in and get a fresh one."

Nio envisions a network of battery replacement shops similar to that of fast-change oil stations. You drive your car in, and three minutes later you have a completely charged battery pack.

Others are thinking of inductive charging, similar to the way mobile phones can be charged today. There's no plug or connector: The car's driver parks over an inductive charging plate, and his battery gets fresh juice.

Charging Stations

Can EVs undergo an efficiency makeover?
To support the growing demand for more efficient electric vehicles, STANLEY Engineered Fastening works with OEMs to develop fastener and assembly solutions that complement electric car manufacturing distinctions. For example, STANLEY replaced steel fasteners with lighter, aluminum ones; developed self-piercing rivets; and perfected stud welding.

The Engineered Fastening division at STANLEY continues in partnership with OEMs to search for solutions and help meet their goals.

"To reduce the weight of cabling, manufacturers want to switch from standard 24V cable connections to bus cables, which are much smaller, lighter in weight and faster," says Vahid Amirzadeh, European Senior Product Manager for STANLEY Assembly Technology.

Another idea proposed to reduce the weight of the wire harness is the use of Ethernet cable, which has the added benefit of facilitating the complex transfer of data in a connected vehicle. Still another is the use of "an unshielded, twisted pair cable to deliver data at a rate of 100Mbps, along with smaller and more compact connectors that can reduce connectivity costs up to 80 percent and cabling weight up to 30 percent," according to a joint study by Broadcom and Bosch, cited in a white paper by Ixia.[5]

While admitting he's not an electronics expert, Amirzadeh can envision future cars that not only don't have internal combustion engines, they have no wiring, either.

"What I see in the future is, sooner or later, they will probably take all of the cabling out of the car and use wi-fi," he said. "That's a way to reduce weight — to use no more cable, or as little as possible. I could imagine that in 10-15 years, you would just have to make sure there's no interference with the frequency of your phone, watch, PC, or Bluetooth."

The trend away from vehicles powered by internal combustion engines, toward an electric future, seems to be inevitable, and that means the design and engineering of EVs will remain very dynamic. Ideas and innovations will continue to flow, just as electrons do from batteries to components, and back to the vehicles themselves.

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Sources

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