Special report: M:bility | Europe – key takeaways

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Executive summary

The automotive industry faces a growing number of challenges as it prepares for a new era of mobility. Autonomous driving, connectivity, electrification, mapping, artificial intelligence, data and Mobility as a Service (MaaS) all play a key role in changes taking place across the automotive industry.

These themes and more ran throughout M:bility | Europe, a two-day event designed by *Automotive World* to help stakeholders from the automotive industry, mobility sector and transportation providers understand the future of mobility.

Topics were addressed in panel debates, a live Q&A and keynote presentations. The event also included a case study on the future of mobility in Stuttgart, where the event was held.

Speakers from NIO, Volvo, the European Commission, Valeo, the City of Stuttgart and ABB were joined at M:bility | Europe by experts from a wide range of companies and organisations with a vested interest in the future of mobility, including Continental, HERE Technologies, Robert Bosch, Deutsche Telekom and Amazon Web Services.

Specifically, the agenda addressed some of the major questions facing automakers and mobility stakeholders:

- What is the future of mobility?
- Mastering maps and sensors–the key to the autonomous car?
- Electric vehicle innovation and its impact on the petrochemical industry
- Artificial intelligence–the ultimate mobility value driver?
- Is 5G connectivity the link to a self-driving future?
- Is automotive data the new oil?
- Automotive 4.0–paving the way for the future with Amazon Web Services
- What does the consumer want from the vehicle of the future?
- Case study–the future of mobility in Stuttgart
- How do we test the autonomous vehicle?
- Is the auto industry prepared for the future of mobility?
- Will mobility as a service become the new normal?
- The future of road transport
- Are electric vehicles ready for the mainstream?
- How will CASE reshape our cities?

Key talking points include:

"I do not see so-called air taxis as being a very good idea. Let's get ground transport running first before considering other things" – Michael Münter, Head of Strategic Planning and Sustainable Mobility, City of Stuttgart

"We've learned the challenges of handling the data generated by AVs–it is time consuming and error prone. Finding the information you need is a headache, and today the process is quite laborious" – Robin Nijor, Vice President of Business Development & Marketing, Renovo

"We are more or less already driving vehicles that are computers on wheels, so I don't think the risk of cyber crime will kill the AV" – Ilijana Vavan, Managing Director, Europe, Kaspersky Lab

"Will MaaS become the new normal? In big cities: yes. In rural areas: not so much" – Jacob Fellman, Associate, NGP Capital

"I strongly believe that automakers will change from being purely producers of a product to enablers of mobility" – Philipp Kemmler-Erdmannsdorffer, NIO

"Autonomous driving does not necessarily solve the traffic issue in urban areas" – Jürgen Bilo, Managing Director co-pace GmbH, Continental Automotive

COMMENT: Future mobility: an urban legend outside of the city?

Future mobility solutions must not leave those in rural areas on the fringes of the discussion, writes Freddie Holmes

Rapid urbanisation in recent decades has driven people closer to city centres, but many continue to live on the outskirts or even further afield in remote communities. Despite this, the subject of future mobility has been dominated by addressing the needs of city slickers; rural dwellers have experienced very little, if any, of the new mobility services being rolled out.

> “Outside of the city, shared mobility is more a case of borrowing the neighbour’s bike

The emphasis being placed on urban mobility is understandable. Cities are bloating and roads that were once designed for horse and cart are struggling to cope with the high volume of today’s traffic. Things are only expected to worsen, with the vast majority of the global population expected to reside in urban areas in future.

Investments in technology and infrastructure also need to serve as many people as possible, and that naturally points toward deploying in a city. “Would I build up a business around the small number of people that live in rural areas around Oxford? No. I can see why the emphasis is on cities,” noted Morgan Holt, Chief Strategy Officer at brand consultancy Fitch, during M:bility | Europe, a two-day conference held in Stuttgart.

Cities are also heavily dictating the demand for electric vehicles (EVs), with free parking in some areas and greater access to charging stations. Earlier in July, the declaration of a ‘climate emergency’ in Paris further underlined that air pollution is becoming dangerously

> The emphasis on urban mobility is understandable. Cities are bloating and roads that were once designed for horse and cart are struggling to cope with today's traffic

high. EVs are largely seen as an answer, but not for those with long commutes from the suburbs just yet.

At the same time, traffic congestion has led many to ditch car ownership altogether in favour of Mobility as a Service (MaaS) options. And not only with cars—e-scooters and pedal-assist bicycles are also on offer. But outside of the city, MaaS in any form could have a limited impact unless things change. Shared mobility here is more a case of borrowing the neighbour's bike, and private car ownership is a given due to infrequent, unreliable or inconvenient public transit links.

> Will MaaS become the new normal? In big cities: yes. In rural areas: not so much

According to Dr. Robert Schröder, Deputy Managing Director at Kantar Automotive, automakers in Europe generally derive around 40% of their sales from vehicles bought by city residents. With 60% of sales coming outside of cities, he suggested that private vehicle ownership will prevail in rural areas for some time to come. "Will MaaS become the new normal? In big cities: yes. In rural areas: not so much," agreed Jacob Fellman, Associate at NGP Capital.

However, those that live out in the sticks should not be forgotten, and as things stand, they look set to be underserved. Benjamin Moncrieffe, Head of Auto+ at customer relationship agency C Space, observed that consumer demand is unlikely to change as rapidly outside cities, primarily due to the fact that cities will take the lion's share of future mobility investments. "The infrastructure in rural areas will slowly improve, but nowhere near the rate that cities will," he explained.

Relieving congestion, improving accessibility for marginalised members of society and reducing the number of road fatalities: that is the mantra of future mobility. However, it should not be exclusive to urban areas and the industry must not underserve the needs of those away from the concrete jungle.

Great expectations: how future mobility may shape society by 2030

A diverse range of stakeholders discuss how the mobility landscape may take shape by 2030. By Freddie Holmes

A period of unprecedented change looks set to roll on for the next few decades, transforming vehicles that were once powered by fossil fuels and driven by a human, to electrically-powered shuttles without steering wheels.

With an automaker, global supplier, research institute and veteran industry consultant on the panel, the opening session of M:bility | Europe, a two-day event organised and hosted in Stuttgart by *Automotive World*, was well set to investigate the topic from all angles.

> “Airline revenue has increased exponentially over the last 20 years, but profits have not. Why should that be any different in the mobility space?

One subject that prevailed throughout was the changing role of the automaker. Having focussed almost exclusively on ‘cars sold’ for the last century, manufacturers are expected to embrace revenue sourced through ‘miles driven.’ As Philipp Kemmler-Erdmannsdorffer of Chinese EV manufacturer NIO suggested: “I strongly believe that automakers will change from being purely producers of a product to enablers of mobility.”

And if current commitments hold true, many of those vehicles will operate as part of a shared autonomous fleet.

Remove the driver, ramp up the profits

Part of the attraction in running a fleet of driverless vehicles is fairly straightforward: no driver means a significant reduction in employment-related expenses. Today, several drivers are often required to operate across several shifts, which can rack up operational costs when scaled across a fleet.

By removing the driver, the model suddenly begins to make real sense. “The ride-hailing business model needs automation in order to create profit pools,” observed Amit Agrawal, a

> Autonomous driving doesn't necessarily solve the traffic issue when it comes to urban areas

Ph.D researcher at the imfo, BMW's independent Institute of Mobility Research.

But profits are not guaranteed when it comes to mobility on demand; the closure of Ford's Chariot operations and scale back of GM's Maven are testament to this. Wolfgang Bernhart, Senior Partner at Roland Berger, pointed to other industries for reference. "Airline revenue has increased exponentially over the last 20 years, but profits have not. Why should that be any different in the mobility space?" he mused.

But will AVs exacerbate congestion?

There is much debate around the levels of autonomous driving laid out by the Society of Automotive Engineers (SAE), but the overriding sentiment of the conference was that Level 4 automation holds the most promise. "I am pretty much convinced that we will see many Level 4 enabled cars on the street in 2030," said Kemmler-Erdmannsdorffer.

Even during the short period in which autonomous driving has been in mainstream testing, the technology would appear to have progressed significantly. However, phrases such as 'just round the corner' are no longer being bandied around. "When it comes to automated driving there is still a way to go," said Jürgen Bilo, Managing Director of co-pace GmbH, Continental Automotive's start-up incubator.

Bilo added that contrary to popular opinion, autonomous vehicles (AVs) could in fact exacerbate traffic congestion: not only will there be more vehicles on the road, but people will want to travel more frequently. "Autonomous driving does not necessarily solve the traffic issue in urban areas. Of course we see automated ride-hailing and ride-sharing coming, but the overall traffic system must be optimised," he added.

A range of limitations

The megatrends often represented by the acronym CASE (connected, autonomous, shared, electric) look set to revolutionise the way people and goods move. However, the outcome is not cut and dry, and the event in Stuttgart aimed to gain clarity on how society may benefit down the line. As can be expected, there will be numerous barriers facing the adoption of CASE mobility.

Continental's Bilo suggested that updating city infrastructure to cater for EVs and AVs could be a significant sticking point. Legislation and regulations will also "pose limitations," he suggested. In addition, e-mobility could be impacted by the availability of raw materials required to produce EV batteries. "One of the limiting factors will be the resourcing of materials," agreed NIO's Kemmler-Erdmannsdorffer. "Magnesium supplies are limited, and very difficult to recycle currently," he added.

On a technical basis, Agrawal suggested that regional variations will cause global players to make a wide spread of investments. Technology designed for one market may not be applicable for another, and that will only slow developments, he explained: "For example, a car designed in Germany may not be able to function in the Middle East." This is already true for new vehicles today, with manufacturers typically designing market-specific variants depending on geography, cost sensitivity and regulatory restrictions.

The cost of developing dedicated CASE vehicles for several different markets would be significant. Instead, most will target scalable platforms that can be used with limited adaptation in various regions–something on which both Volkswagen and Volvo Cars in particular have already made fair progress.

Choose your partner(s)

Manufacturers will not only handle sky-high investment costs by developing scalable products. Those products will also be built in partnership with the assistance of outside expertise, be it with existing competitors or players from entirely separate markets.

"If you look at the CASE acronym, it would be fine to replace 'connected' with 'collaboration'," Agrawal explained. "One player cannot go it alone, and there will be alliances across the fence."

Consider the Ford-Volkswagen alliance and Daimler-BMW mobility joint venture as prime examples, but numerous other tie-ups have illustrated the challenge of going solo when pursuing future mobility.

Alternative propulsion: a one horse race?

The overwhelming expectation from the event was that battery electric vehicles (BEVs) will take the mass market by 2030, with plug-in hybrids also holding strong.

Scandals involving diesel emissions testing have opened up an opportunity for BEVs to sell their case, noted Kemmler-Erdmannsdorffer. "Thanks to Dieselgate, the deck has been shuffled," he said. "This will allow new technologies to hit the street."

EVs have also gained a clear lead on hydrogen fuel cells to date, although from a commercial vehicle perspective, the opposite is true. "I love hydrogen technology," said Kemmler-Erdmannsdorffer. "It's clean and a nice way to have the car refuelled, but how can three conversions of energy be the most efficient approach? I don't see the technology taking off in a big way with passenger vehicles over the next ten to 20 years."

> "We foresee regulations moving from the paradigm of air pollution to the politics of space and its usage

On the other hand, said Bilo, "BEVs will take the mass market." Agrawal suggested that battery prices of around US$90kwh should be a turning point for mass EV adoption.

From clean air to green space

Accurately forecasting how the future of mobility may look is no mean feat when existing trends are in such a state of flux. There is also little clarity as to how or when certain technologies may successfully be deployed. Events such as M:bility | Europe are in part an effort to gauge expectations, but also an opportunity to hear first hand what is going on behind the scenes.

A standout takeaway was that by 2030, an extra 'S' might be added to the CASE acronym: space. Agrawal believes that on a broad level, the current focus on clean air will eventually shift toward making the most of a city's available space. As air quality improves, eyes will turn toward the scores of traffic jams and lack of green space in city centres, he concluded.

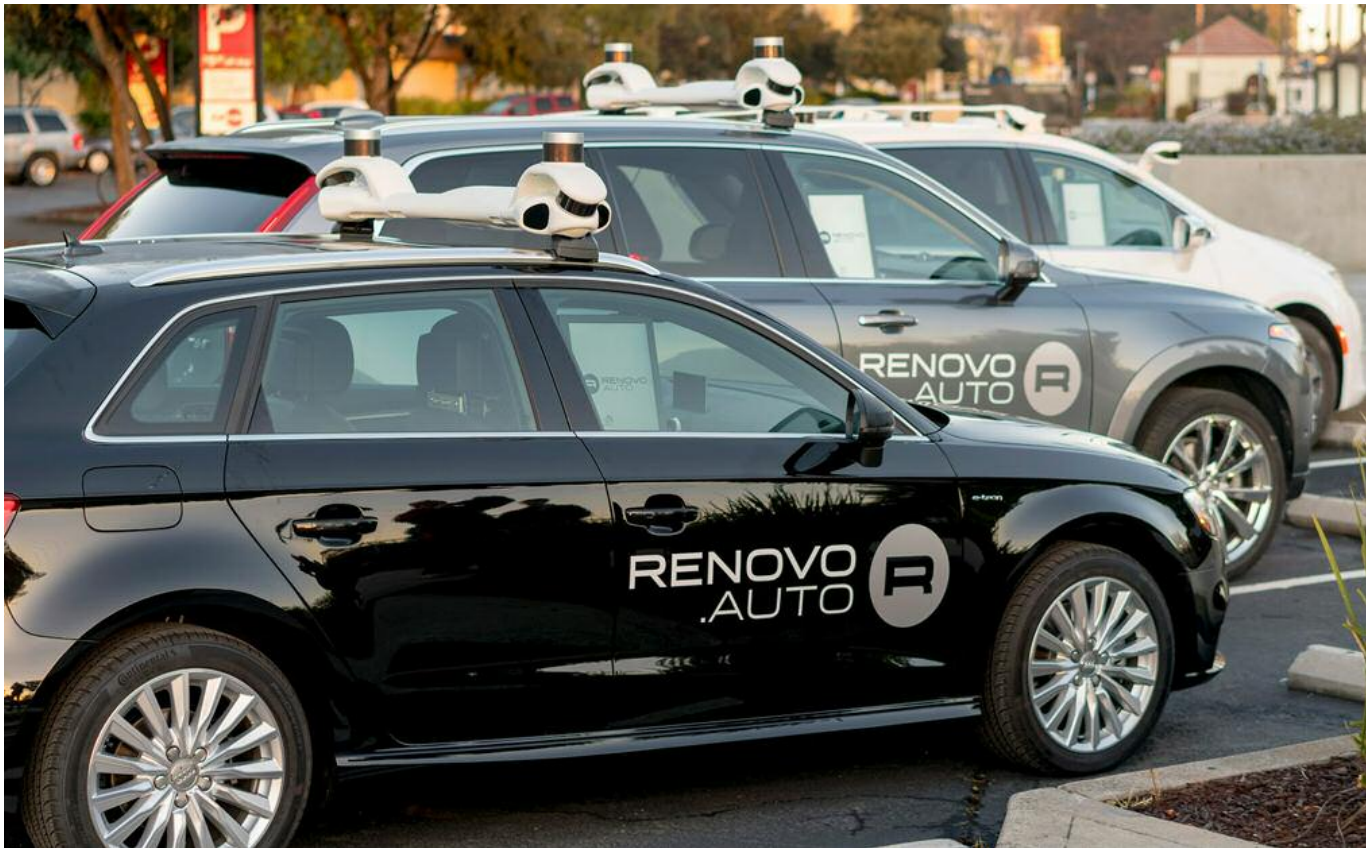
"Regulators will respect societal attitudes, and we foresee regulations moving from the paradigm of air pollution to the politics of space and its usage," he said, "and that will require many different modes of transportation."

New tech tackles the 'headache' of analysing AV test data

Autonomous vehicle testing generates swathes of data. Analysing all that data can be time consuming, but a new approach could save development teams weeks. By Freddie Holmes

Sifting through the terabytes of data generated each day by an autonomous vehicle (AV) test fleet takes time. Today, the process can take weeks as developers try to pinpoint particular corner cases from video footage.

In some cases, a day's worth of driving can produce just five minutes of useful material. The days and weeks required to identify and export that data is killing the efficiency of the AV development process.



> The most important events and correlations are flagged and made available quickly, even across an entire fleet of vehicles

"We've learned the challenges of handling the data generated by AVs–it is time consuming and error prone," said Robin Nijor, Vice President of Business Development & Marketing at Renovo, during the M:bility | Europe conference in Stuttgart. "Finding the information you need is a headache, and today the process is quite laborious."

Indeed, teams today often have to remove numerous hard drives from a fleet of vehicles and send them via truck to the back office development team. With Insight, a new product launched by technology firm Renovo, those hard drives can be removed and plugged in on site, with data sent up to the Cloud.

Test teams can run a vehicle on the road and at the end of the day leave Insight to do its work, cutting development time dramatically. Renovo estimates that Insight is currently ten times faster than the current AV/ADAS data process, with storage requirements reduced by as much as 20 times.

> When it takes weeks to get data to a development team today, clearly there is room for improvement

"There is a race right now, and when it takes weeks to get data to a development team, clearly there is room for improvement there," he explained. "Now, the developer is getting the data they need on the same day and can even find out whether they need to re-run a test rather than waiting weeks. The key here is reducing time for developers."

Borne out of a collaboration with Stanford university, Insight is a continuation of a technology that has been in development for years. In essence, the technology indexes vehicle and sensor data to build a correlation across all recorded sets.

The most important events and correlations are flagged and made available quickly, even across an entire fleet of vehicles

The idea is that AV development teams, be it an automaker or independent third party, can get hold of the most important data with limited delay. The rest of the data can be put into cold storage for compliance purposes or to analyse later on.

While its customer base is confidential for the moment, Nijor did advise that Renovo has been working with Voyage, a self-driving car developer operating test fleets in San Jose and Florida. Renovo is also working directly with a range of automakers, Nijor advised.

What does future mobility mean for a fluid management specialist?

The introduction of hybrid and electric vehicles promises new opportunities for dlhBOWLES to apply its existing expertise. By Freddie Holmes

For a company that is well invested in conventional vehicle platforms, the so-called death of the internal combustion engine (ICE) would surely set alarm bells ringing. However, as has proven the case for many players across the supply chain, the gradual advance toward hybrid electric vehicles (HEV) and battery electric vehicles (BEVs) is proving an opportunity, not a threat.

US-based engineered plastics and fluid management firm dlhBOWLES has been developing thermoplastic solutions used in ICEs for decades. While it is not a powertrain company, diesel and gasoline engines account for a significant amount of business, with various fluids and gases from the engine requiring circulation or displacement. But what happens when the vehicle is propelled by electricity?

"Even though there may be a reduction in content in particular product lines associated with ICE vehicles, there is increased content with other products," said Russell Hester, Director of Business Development at dlhBOWLES. "Given the overall vehicle architecture of HEV and BEV programmes, it will prove to be a net benefit in terms of content per vehicle."

> "There may be a reduction in content in particular product lines associated with ICE vehicles, there is increased content with other products

Indeed, EVs bring their own particular requirements for coolant to be circulated around the vehicle and, more specifically, around the battery. Unlike traditional ICE vehicles, the battery does not reside in the confines of an engine bay, but across the floor of the vehicle. As such, thermal management systems will require more tubing to transport the necessary fluids, and keep the battery and its associated power electronics at an optimal temperature.

EV vs. ICE

Forecasts suggest EVs are set for rapid growth in coming years, but diesel and gasoline continue to dominate the passenger car market. That being said, the long-term impact on the supply chain needs to be considered sooner rather than later, and dlhBOWLES is making a proactive effort to understand how the future of mobility may impact its operations.

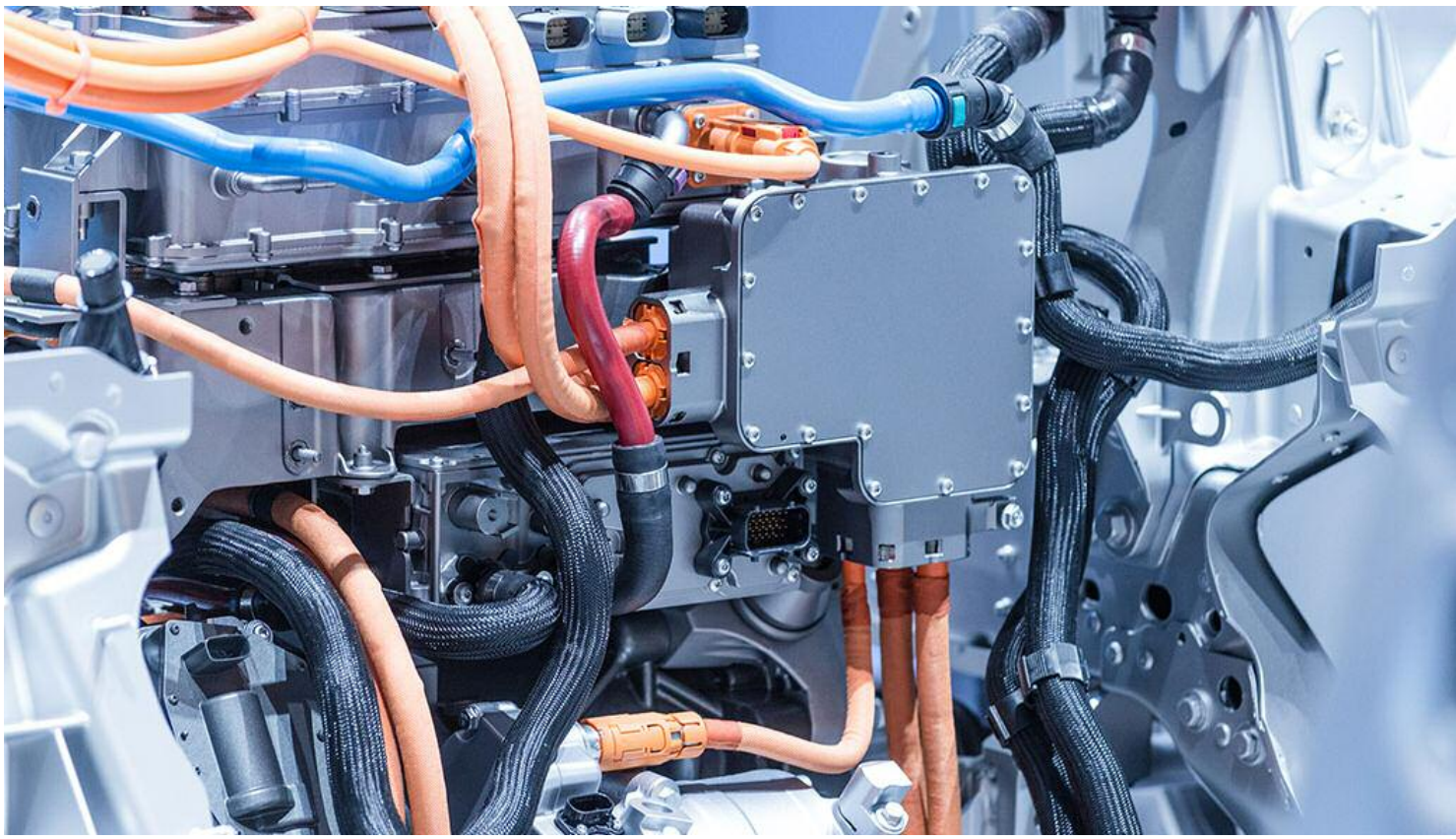
"It is clear that the ICE is not going away any time soon, and much of our product lines will continue to exist, even on smaller engines; it is more a matter of looking at the rise of EVs and understanding how we can grow amid a slight reduction in ICE volumes," explained Hester.

"In the short- and medium-term, the move toward EVs is not a threat but something we need to anticipate as a company," added Daniel Konrad, Vice President of Engineering at dlhBOWLES. "We need to be a part of this change, rather than being surprised in eight or nine years when the ICE market has shrunk. It is an opportunity to adapt to the changing markets in advance, because they are not changing overnight."

Get connected

For dlhBOWLES, initial investigations have shown that the company will not be required to pivot and find a new direction, but instead tweak the existing portfolio to prepare for changes the EV trend will bring.

For example, the firm has played a key role in the transition away from heavy rubber hosing in combustion engines, such as those used in positive crankcase ventilation (PCV) systems. By substituting traditional hoses with lightweight thermoplastic tubing, automakers can save weight and time during their integration on the factory floor. Networks of thermoplastic tubes will remain in the picture for hybrid powertrains, advised Hester, and thermal management of battery packs will bring even more tubing.



EVs bring a new requirement for coolant to be circulated around the vehicle and, more specifically, the battery

> Because of the skateboard design in a scalable EV platform, coolant tubing runs along almost the entire length of the wheelbase

What's more, they all need to be held in place by connectors–an area in which dlhBOWLES is already well versed. "As an expert in thermoplastic extrusion, we feel that is probably the most appropriate path moving forward for many of these vehicles coming out in the future."

Scalable EVs

Another positive trend is that many automakers are pursuing scalable platforms that allow multiple models to sit on the same architecture. It comes as part of a push to improve manufacturing efficiency and cut costs, a challenge that is particularly pronounced when making EVs at scale.

A common design has come to the fore, known as the 'skateboard' layout. It alludes to the placement of the battery–low to the ground and situated between the front and rear axles. Naturally, this opens up potential for growth as thermal management becomes a must-have. "In an ICE, especially in a front-wheel drive vehicle, the whole package is essentially under the hood. Systems are not well distributed, and all attached to the engine," said Konrad. "But because of the skateboard design in a scalable EV platform, coolant tubing runs along almost the entire length of the wheelbase."

Coolant lines run through the front motors, rear motors and the battery pack, for example. Thermal management is key as it affects how quickly the vehicle can charge, how far it can travel, and how safe the battery is. "Liquid cooling seems to be a must in this kind of application," added Konrad. "Sealed, convection-cooled batteries are comparatively rare today."

The idea is to create scalable architectures that can underpin a range of models across the range. For example, Volkswagen is investing more than €1bn (US$1.1bn) to prepare its Zwickau plant in Germany to produce vehicles based on its modular electric drive toolkit (MEB) platform; Volvo Cars is leveraging its compact modular architecture (CMA) platform across the portfolio, including that of sister brand Polestar; Toyota and Subaru have agreed to co-develop a platform designed for mid-size and large BEVs; and the first vehicles based on Jaguar Land Rover's modular longitudinal platform (MLA) are expected by 2021.

"Based on what the big players are doing, we foresee fewer dedicated platforms in future. We want to help our customers find scalable solutions that support these flexible platforms," said Konrad. "With standardised quick connectors and fluid tubing routings, we should be able to accommodate these scalable platforms very well–you can essentially extend those same products to any vehicle. We feel this naturally leads to standardisation of coolant systems and other componentry."

Continued business

While the powertrain electrification trend has dominated the headlines of late, it is not sparking a revolution just yet. With the ICE still firmly in the picture, dlhBOWLES will not

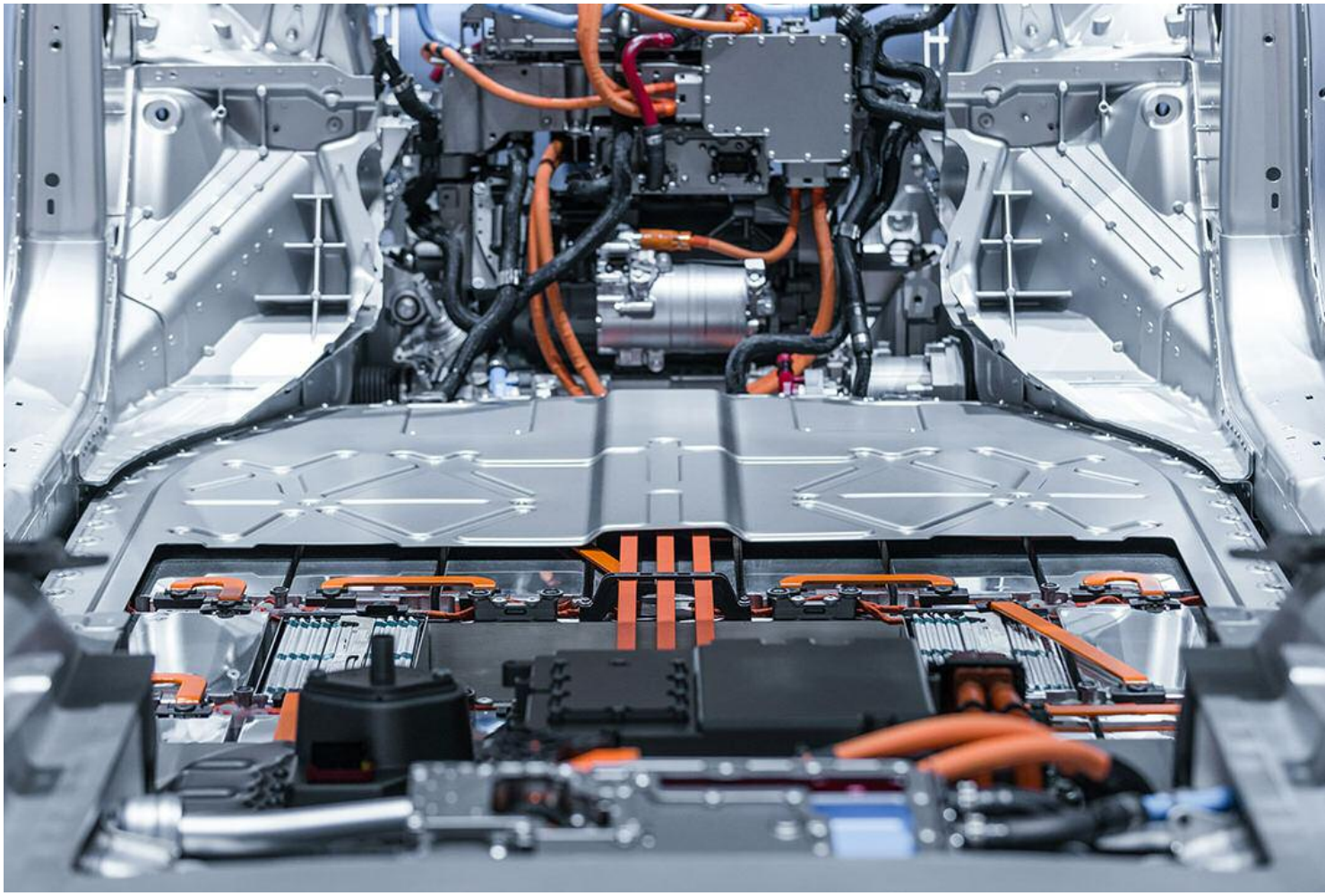
focus exclusively on electrified vehicles moving forward. It is however readying itself for what may come.

"It goes without saying that our existing portfolio–including other products such as sunroof drain tubes, all the other washer tubing and associated connectors–will stay with us throughout this transition," Konrad said. "We are well diversified in various areas of the vehicle, and as such are not apprehensive about the future–we see it as an opportunity and will adapt to understand our customers' needs."

"From an outside perspective many would think that adapting to the evolution of mobility within the automotive industry requires the supplier base to rely on breakthrough innovation," added Hester.

> "It is more a matter of looking at the rise of EVs and understanding how we can grow amid a slight reduction in ICE volumes

"However, we recognise an additional path of creatively applying our existing knowledge and capabilities to generate ongoing growth and value. Fluid management on a vehicle is often constrained by a traditional mindset, a mindset we plan on shattering."



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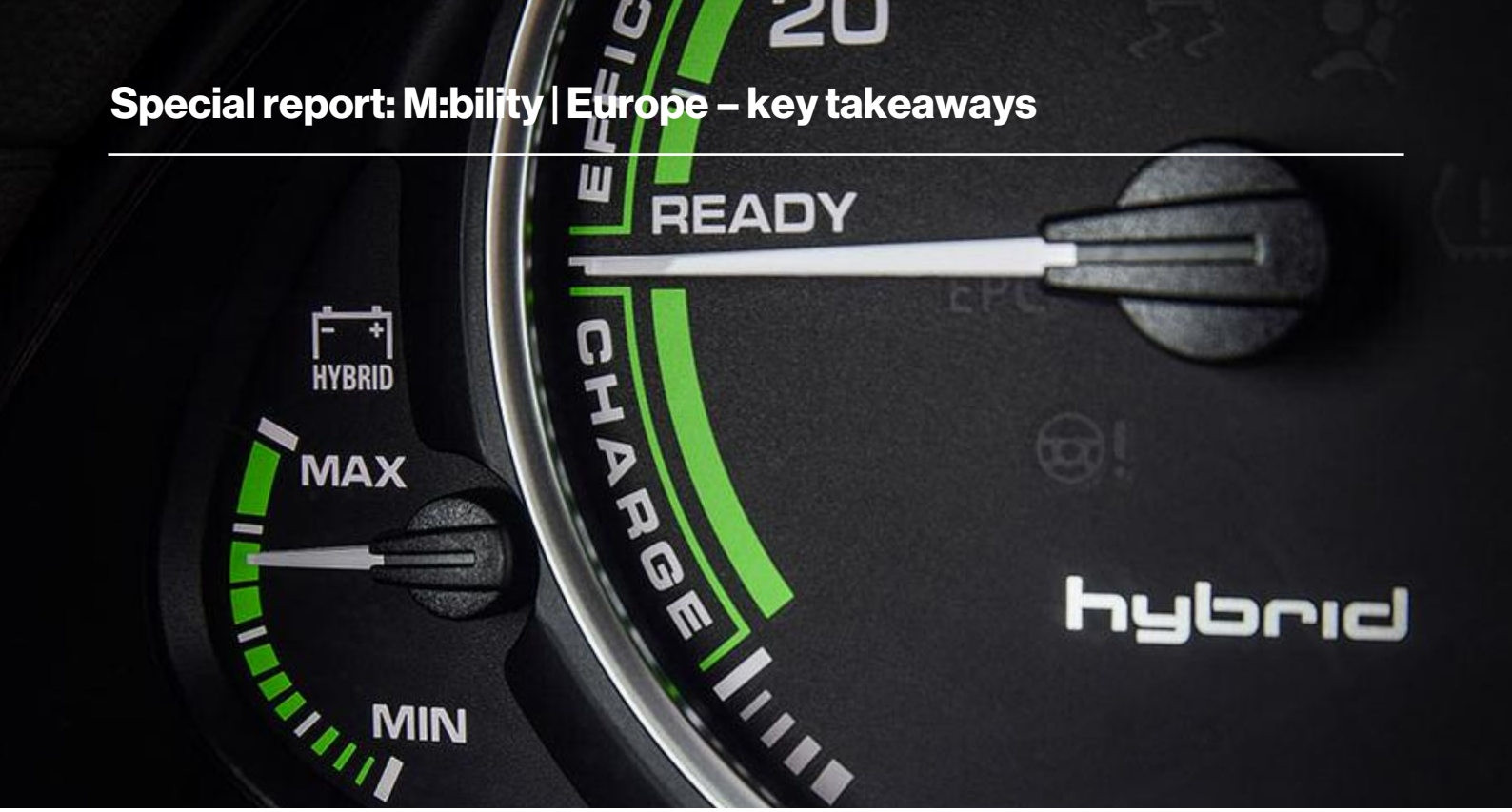


Great chemistry: future powertrain tech needs chemical expertise

With new powertrain architecture comes the need for dedicated additives for lubricants, thermal management fluids and battery performance, as well as performance polymers for cell chemistry. By Freddie Holmes

Autonomous driving and artificial intelligence may dominate the headlines, but the future of mobility does not change the need to keep moving parts running smoothly. Indeed, lubrication may not be at the forefront of the industry's mind amid talk of shared mobility services and driverless cars, but without continued innovation in performance chemicals, these vehicles would soon grind to a halt.

Most passenger car powertrains will continue to rely on internal combustion engines (ICE) for the foreseeable future, but electrification is increasing with each model cycle. As of 2019, every new Volvo car will feature some degree of electrification; Volkswagen stated in March that it will launch 70 new electrified models over the next decade; and Toyota already offers varying degrees of hybrid powertrains across its model range.

At the same time, combustion engines are largely becoming smaller; rather than relying on cubic capacity for performance improvements, most units utilise forced induction to eke out additional power and efficiency. In tandem, all of these changes mean that performance fluids will need to be tailored for the complex demands of anything from a downsized three-cylinder gasoline engine all the way through to a full battery-electric powertrain.

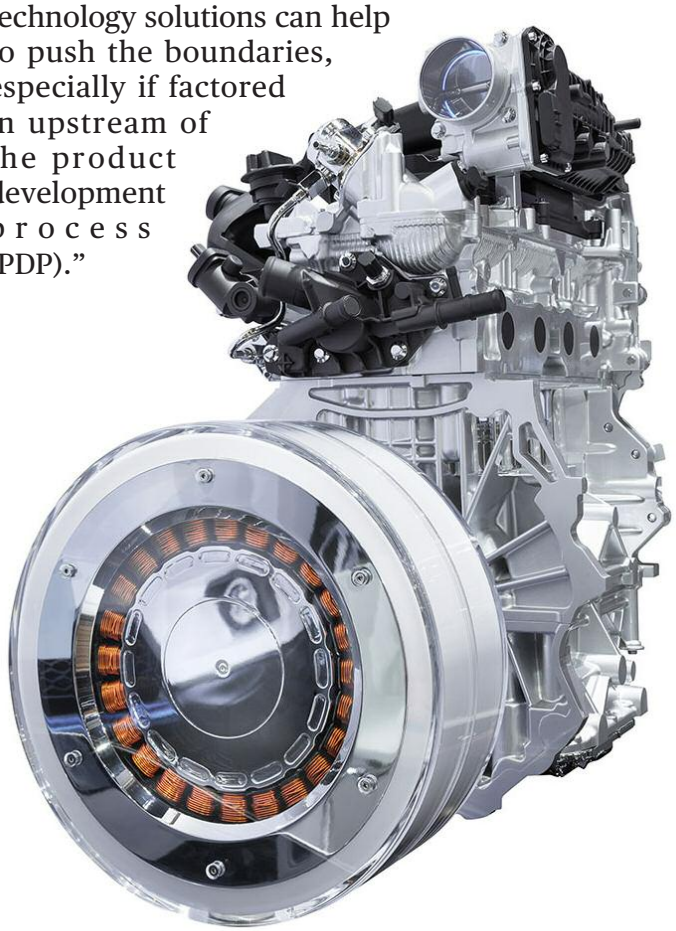
Next-generation chemistry

Formulating new lubricants and chemicals that help to keep powertrains ticking along has become increasingly complex in recent years. Whenever a component or sub-system is electrified, the role of the ICE changes slightly, and fluids that may once have been ideal now need to be adapted. It is a change that needs to be embraced, according to speciality chemicals firm Lubrizol.

"The petrochemical industry is very aware of the disruption coming from electrification, and the question we all have to ask ourselves is whether we see it as a threat or an opportunity," says Xavier Branquet, Global Lead, Electrification and E- mobility, OEM Group at Lubrizol. "When shaping e- mobility solutions, we realised that our portfolio goes far beyond lubricants only. That is why we are embracing electrification, because we truly see it as an opportunity to elevate our game."

While a move away from the ICE would suggest lost business for a company that has built its legacy around the technology, Lubrizol is preparing for the next generation of mobility by expanding in two key product areas of electrified vehicle technologies, namely: 'E-Powertrains', which will include e-driveline fluids, hybrid- compatible engine oils, and e-greases; and the 'E- Powerplant', which will focus on battery cell chemistry, engineered polymers and thermal management fluids.

"The pace of electrification is accelerating so fast that most automakers and Tier 1s are concentrated on developing the hardware," explained Branquet, "but the lubricant is rarely factored as a strategic engineering integrated component. Our technology solutions can help to push the boundaries, especially if factored in upstream of the product development process (PDP)."



> New generations of e-motors run far higher in terms of revolutions per minute—above 18,000—and thus will need dedicated e-greases to achieve energy efficiency, increased durability, noise reduction and reduced electric arcing

> The pace of electrification is accelerating so fast that most automakers and Tier 1s are concentrated on developing the hardware, but the lubricant is rarely factored as a strategic engineering integrated component

A hybrid approach

Electrified powertrains have evolved the kind of fluids that are necessary to keep them running optimally, and Lubrizol is conscious that different electrified systems and driveline hybrid cycles can have an impact on elements such as transmissions fluids and the engine oil respectively.

Electrified transmissions such as an electric double clutch transmission (DCT), for example, will have different requirements to a traditional DCT in terms of electrical and thermal conductivity as well as compatibility with a growing array of electrical components, wires, sensors and new materials, and electrical properties.

Then comes a requirement for so-called 'e-greases', which will be required for electric motors. "New generations of e- motors run far higher in terms of revolutions per minute– above 18,000–and thus will need dedicated e-greases to achieve energy efficiency, increased durability, noise reduction and reduced electric arcing," explained Branquet. "We are also seeing the trend of the integration of e- motors, inverters and reduction boxes together. That will require one sole fluid to serve each individual element."

Battery management

Lubrizol has also curated a set of solutions that are already being utilised across the battery ecosystem. From battery cell chemistry that includes electrodes insulation, materials for the electrolyte and engineered polymers for electrode binders to hyperdispersants–which provide electrostatic stabilisation–the company is far from reliant on the ICE.

The next generation of plug-in hybrids (PHEVs) is expected to feature slightly larger batteries to boost electric driving range from around 30 miles (48km) to 50 miles in future. This means that the E-Powerplant–the vehicle's batteries and associated components–will become just as important as the ICE in propelling the vehicle.

"The battery landscape is becoming very important for us," said Branquet. "It is important to consider what the dominant source of power will be, and not only for BEVs but also for hybrids. For example, in the PHEV of the future, you could drive in full electric mode all week long and only use the ICE on the weekend for longer drives. The battery and its operation, including thermal management, becomes an extremely important consideration."

Lubrizol is even developing engineered polymers for electric vehicle (EV) charging ports, modules and cables, which among other things must be flame retardant, flexible and resistant to ultra-violet light. "This is why we embrace electrification because while some legs of our business will have less volume, it opens up new chemistry opportunities beyond automotive–even in the infrastructure business."

Reliability

Despite the raft of changes under way, powertrain developers must ensure that all architectures continue to run at an optimal level. Among other things, that means keeping heat, friction and corrosion in check. The challenge is also to ensure that these powertrains arereliable.

"Durability becomes increasingly important because some transmissions, such as those in a battery electric vehicle (BEV), are designed to last for the vehicle's life," noted Branquet. "It is vital that the right fluid is used in the first place so that the vehicle operates at the desired level for its lifetime."

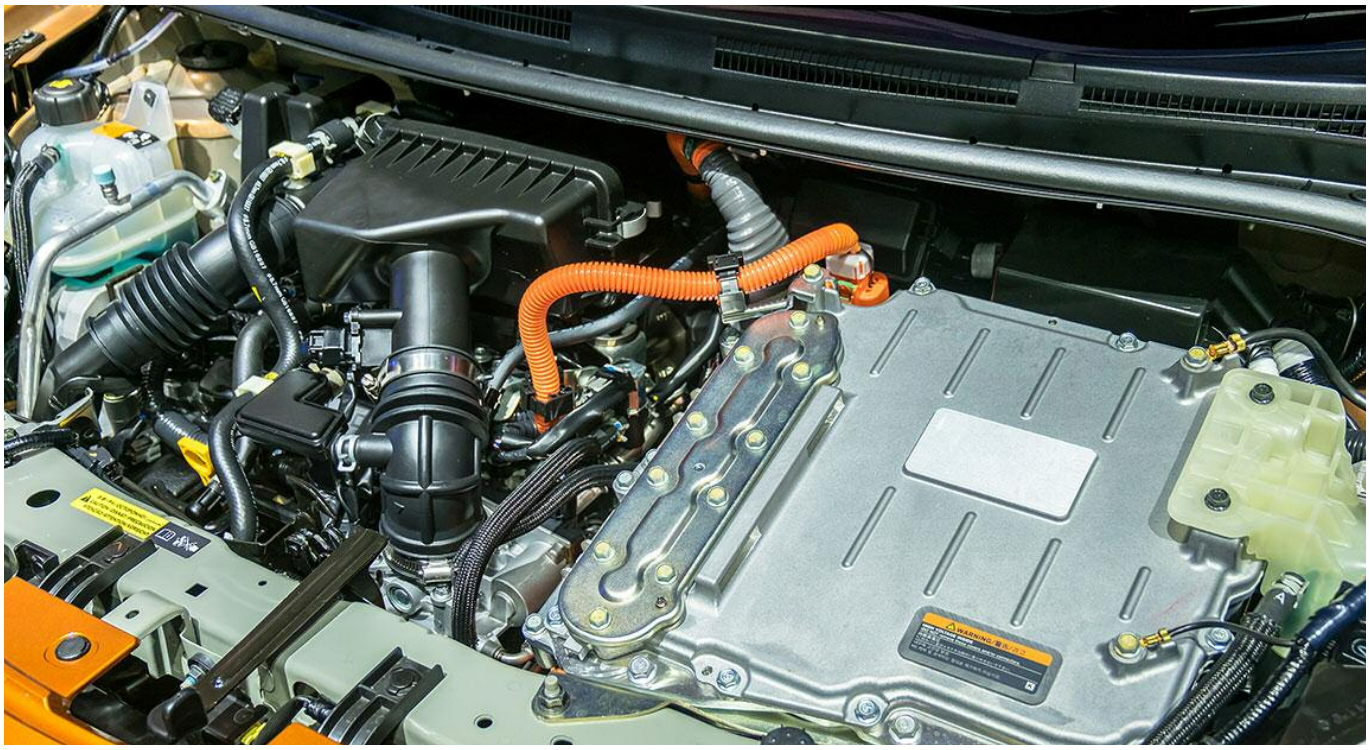
'Filled for life' describes an automaker's requirement for reliability. In this case, it means there should be no warranty issues up to a certain mileage– typically around 200,000 kilometres. Some manufacturers may cover the vehicle for its entire life cycle, which most gauge as being around 300,000 kilometres today. If the lubricant is not up to the task, it could spell mechanical disaster down the line.

"Durability and efficiency is a must-have, and this is where optimised electrical and material properties kick in," said Branquet. Over time, ill- performing lubricants could lead to the deterioration of materials, such as gap fillers in an e-motor. This could lead to mechanical failure. In addition, oxidation could also occur, leading to an increase in fluid viscosity and thus a drop in efficiency. "Any mechanical failures not only impact the efficiency, safety and performance of the vehicle, but also the automaker's reputation," added Branquet.

An end-to-end solution

Upcoming generations of the powertrain will require a new focus on engine oils, driveline e-fluids and e-greases, and automakers must also be mindful of the different hybrid cycles and battery architectures that come into play. E-mobility is changing the game, and manufacturers may no longer be able to reach for existing off- the-shelf solutions.

While Lubrizol has built its reputation in the transportation space for the last 90 years, Branquet is confident that the company is well positioned to meet the coming demands of future mobility. "We see electrification as irrevocable, and a continuity of our existing business," he concluded. "It is a great opportunity for us to leverage the strengths of Lubrizol because we can offer end-to-end e-mobility solutions for the E-Powertrain, E-Powerplant and beyond."



E-mobility is changing the game, and manufacturers may no longer be able to reach for existing off-the-shelf solutions

COMMENT: Could cyber threats kill the autonomous car?

Every cyber attack erodes consumer trust, but could this spell the end for autonomous vehicles before they have even begun? By Freddie Holmes

Connectivity is revolutionising new vehicles, which in future will generate as much as 4,000 gigabytes of data each day. However, whenever a device is connected to the internet, the risk of a cyber attack arises. Throw in the expectation that many vehicles will eventually be capable of driving fully autonomously, the potential ramifications of a fleet-wide cyber attack are grave.

At M:bility | Europe, a two-day conference held in Stuttgart to investigate the future of mobility, experts discussed the challenge facing the automotive industry in this regard. In fact, the question arose as to whether the threat of criminals taking remote control of real vehicles could prevent autonomous vehicles (AVs) from hitting public roads altogether.

> There is a chance that people will reject AVs due to the risk that it could kill you

"Fatalities are being accounted for much stronger with AVs—we see these single events as being more severe than the thousands of traffic fatalities we see across entire countries," said Eduard Groen, Engineer, Department of User Experience and Requirements Engineering, Fraunhofer IESE. "Any fatality at the moment is one too many, and there is a chance that people will reject AVs due to the risk that it could kill you."

That being said, the counter argument is that any opportunity to prevent a road fatality with autonomous driving should be embraced. Fear of adopting AVs could prove more damaging, and as one panellist pointed out, many new vehicles are already fitted with semi-autonomous features. The risk is here today, but that hasn't stemmed demand for in-vehicle technology just yet.

Indeed, this allowed now-notorious 'white hat' hackers Charlie Miller and Chris Valasek to immobilise a Jeep Cherokee not once, but several times. It even led to a federal recall of more than 1.4 million vehicles in the US. Similar research-led probes into the cyber security of other connected vehicles like the Nissan Leaf, Tesla Model S and Mitsubishi Outlander PHEV, for example, have only underlined the point that today's vehicles are already targets for remote attacks.

"We are more or less already driving vehicles that are computers on wheels, so I don't think the risk of cyber crime will kill the AV," said Ilijana Vavan, Managing Director, Europe, at Kaspersky Lab. "Moving forward, it's important that cyber security companies collaborate closely with the automotive industry. It is a game of cat and mouse—I don't think cyber criminals will put people in danger, but more a case of ransomware... Unless it is a terrorist organisation."

> We are more or less already driving vehicles that are computers on wheels, so I don't think the risk of cyber crime will kill the AV

Christoph Gauger, Partner and Managing Director at The Boston Consulting Group, is confident that the industry will be able to keep cyber attacks at bay. "Is there a risk that cyber crime could kill the development of AVs? Yes, but I have trust in the automotive industry to find a way," he said. This will likely require research-led hacks to continue in order to highlight any flaws in the system, and while costly in several ways, unexpected criminal attacks would also prove a catalyst to secure vehicles. "As an industry, we learn from failures quickly," he concluded.

What is the future of mobility in Stuttgart?

Mobility as a service could prove tricky to implement in a city that favours owning a vehicle, walking and using trains. By Freddie Holmes

Home to numerous household names, Stuttgart is one of the automotive industry's most prestigious manufacturing hubs. At M:bility | Europe, a two-day event held in Stuttgart, *Automotive World* investigated how the city is addressing existing mobility challenges, and how technology can be deployed to improve the quality of life for its residents and visitors.

The CASE (connected, autonomous, shared and electric) megatrends are widely considered to have an inevitable impact on the developed world over the next few decades. However, radical technology shifts may not be necessary in reducing traffic-related congestion, emissions and fatalities.

Stuttgart is already a city that walks–around a quarter of all journeys are carried out by foot–and while its public transit links are far from optimised, many travel to work and play by train. Driving a vehicle into the city centre is becoming increasingly challenging, but private ownership also remains high: the city recently registered the highest number of cars on its roads for the last ten years.

What does this all mean for the industry's ambition to launch the latest and greatest technologies and business models?

> "In Roman times we had roads and carriages, and today's mobility challenges have not changed much since then. We really need to rethink things, but without destroying half of the city

On your bike

Indeed, the automotive industry has recognised that the future of mobility will not revolve around the car, and manufacturers are investigating how to compete–and in some cases play– with the likes of electric scooters and bicycles.

Stuttgart is not a particularly large city, with a population of just over 600,000 residents, but its geography presents a number of challenges from a mobility standpoint. The city is

surrounded by forests and lies amid a range of deep valleys and hills. The River Neckar also flows south through the eastern flank of the city, and this could all make any radical changes to infrastructure tricky.

"We have bridges across rivers that have been around for hundreds of years, so drastic changes to infrastructure and roads cannot be done easily," said Patrick Dufour, Managing Director of Wirtschaftsförderung Raum Heilbronn GmbH, a business promotion firm based in the Heilbronn district to the north of Stuttgart. "In Roman times we had roads and carriages, and today's mobility challenges have not changed much since then. We really need to rethink things, but without destroying half of the city."

Given its scattering of hills, commuting by bicycle has never been hugely popular around Stuttgart. "You cannot commute on your bike as you will need a shower before starting work," said Dufour. However, the recent boom in pedal-assist bicycles has begun to change the mind-set of locals. Today, those tiny electric motors can make a daunting task a breeze.

"There has been a significant rise in bicycle use, but admittedly from a very low level," advised Michael Münter, Head of Strategic Planning and Sustainable Mobility, City of Stuttgart. Around 5% of road users were cyclists ten years ago, he noted, which has grown to around 8-9% over the last ten years. "We have a lot of hills and an altitude difference of 400m, but with e-bikes this is no longer an excuse for not cycling," he observed.

Air quality

With a low emission zone in effect and a ban on older Euro 4 diesels, the city follows a wider global trend to improve urban air quality. A further restriction targeting slightly newer Euro 5 diesel vehicles is under consideration for 1 January 2020, but will only come into action pending a review of the current ban.

City officials have also been involved in roundtables with automakers, major suppliers and energy companies to understand how electric vehicles can be introduced en masse. In 2012, Daimler launched a fully electric car sharing service in Stuttgart under the Car2Go brand. According to Münter, this was to experiment with EVs "not only in small pilots but on a city-wide basis."

As of June, Stuttgart had around 10,000 alternative propulsion vehicles on its roads, including mild hybrids, plug-in hybrids (PHEVs) and BEVs. "In German terms, it's quite a lot," Münter mused. However, teething pains remain for EVs in general, some of which are legacy issues. "The number of cars being registered here is rising, but there is also a huge parking problem in our city," said Dufour. Regardless of the method of propulsion, it is simply getting harder to pack in more cars on Stuttgart's streets.

Ultimately, the goal is not to add more cars, but to encourage existing drivers to swap their purchasing preference to a plug-in vehicle. If EV adoption does rise, the city is well prepped with a "dense electric recharging infrastructure," advised Münter.

Public transport

Stuttgart's S-Bahn is a rail network that runs throughout the city over seven lines, with all routes passing through the city centre. For many, it is seen as unreliable and sluggish in its current form—the shortest interval between trains is 15 minutes, and that is during peak rush hour. A dual-track tunnel through which three lines pass also creates a bottleneck.

"Unfortunately we do not have the opportunity to add more trains, and this is something that cannot be changed very quickly," said Münter. Despite this, he advised that public transportation use is generally on the rise.

A major inter-city rail project known as Stuttgart 21 has also trudged on; it was originally announced back in 1994, but construction work only began in 2010. Since then, the estimated cost of the project has ballooned, and Stuttgart residents continue to suffer from ongoing construction work that

> Stuttgart is interlinked with the other rural areas around it, and we really need to look at optimising that aspect

causes frequent delays. A mixture of over ground and high-speed lines are currently being built, with an estimated completion date of 2021.

It is a touchy subject that has drawn widespread public criticism, much like the HS2 rail project under way in the UK. Protests against the Stuttgart 21 project have been heightened amid the demolition of buildings to make way for new tracks, but a referendum in 2011 found that the majority of locals were in favour of the project to continue–albeit amid suggestions that bailing out would ultimately be more expensive.

"Stuttgart is interlinked with the other rural areas around it, and we really need to look at optimising that aspect," said Dufour. "Many commuters are not necessarily using public transportation just yet, but are starting to consider it."

New tech

With talk of growing private vehicle ownership, delayed trains and a penchant for walking, Stuttgart would not appear to be a poster child for future mobility as it has been with automotive manufacturing. However, technology innovation is still expected to play an important role in helping people and goods move around the city.

For example, the S-Bahn is currently trialling a new coloured signalling system to indicate how busy each carriage is when a train reaches the platform. The idea is that passengers can enter and exit trains as quickly as possible, and trains will be less densely packed overall. "One light could show that a carriage is very busy, while another light could say the adjacent carriage is relatively free," explained Münter. His department is also investigating how a comprehensive smartphone app can be used to access different modes of transport and shared services across the city with ease. "These are things we are testing in order to make things better," he advised.

> MaaS and CASE are in the city today

Münter also highlighted that much of the technology presented as being far off in the future is already in use. For example, connected navigation services have helped travellers get around the city for years; strong electric charging infrastructure supports a fleet of shared EVs; and the city has the largest inter-regional bike-sharing system in Germany. "MaaS and CASE are in the city today," he affirmed.

As for talk of air taxis or 'flying cars', do not hold your breath: "I do not see this being a very good idea," Münter concluded. "Let's get ground transport running first before considering other things."