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Is this the new template for EV design?



Aehra redefines premium e-mobility | **Tesla** stock warnings escalate |
Motional and **Uber** aim for record robotaxi deployment | **Halo.Cars** brings together CASE threads |
CELERITAS slashes battery charge times

04 Aehra aims to change the shape of EVs with new SUV



10 Warnings on Tesla stock bubble grow louder

14 Uber and Motional target record robotaxi deployment

18 Cost and compatibility challenge ultra-fast network rollout

The road to robotaxis will be an iterative journey

Where next for wrong-way driving detection?

Mobility innovation stalls in Russia

22

26

30

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34



38



44



48



54



58

34 Manufacturing data: too much of a good thing?

38 Automakers must reconcile EV ownership with affordability

44 On-demand services are changing attitudes to car ownership

48 What does sensor fusion mean for the future of radar?

50 Euro 7 highlights economic vs environment debate

54 As charging times drop, battery tech must evolve

58 Location data: the keystone of the software-defined car

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Cover image courtesy of Aehra

Aehra aims to change the shape of EVs with new SUV

Will Girling attended the launch event for Aehra's all-electric SUV, which is aiming to redefine the high premium vehicle market

On 8 November 2022, Italian electric vehicle (EV) start-up Aehra unveiled the design prototype for its SUV model. Currently scheduled for release in 2025, the car is intended as the opening movement of a broader strategy that aims to transform electric mobility. Speaking at the event in Milan, Chief Design Officer Filippo Perini proclaims, “The internal combustion engine (ICE) game is over. EVs are truly the superior modern experience.”

Premium, not luxury

Featuring a monobody architecture more commonly used in supercars, the Aehra SUV prioritises ergonomics, aerodynamics and space. The cab-forward design shortens the front-end significantly, the mirrors and ‘A pillars’ are inspired by race motorcycles, and the overall shape functionally provides thermal management for the brakes and battery. It features a 120kWh battery powering three motors, delivering almost 800bhp. Its target range spec will be 800km from a single charge.

The unique structure, says Chief Executive Hazim Nada, is a deliberate breakaway from EV silhouettes that he believes look too homogenous—[echoing the sentiments of other OEMs](#). The car will not be given a specific name when released. The exact motivation is unclear, although Nada did proffer that it is “a conscious effort to distance itself from market segment competitors.”

Concerning the design of the Aehra SUV, Nada emphasises to *Automotive World* that it is a “high premium” vehicle—as distinct from the luxury market—and that “premium means European.” For him, this encompasses high quality materials, finishings, and performance that deliver everything customers need and nothing they don’t. “For high premium, you’re talking about a price tag between US\$160,000 and US\$180,000. We see that segment as the fastest-growing broadly, both in terms of gasoline/diesel and EVs: it’s growing 10% year-on-year,” explains Nada. The Aehra SUV has a provisional price tag of US\$180,000.

The vehicle will be engineered for SAE Level 4 autonomous driving capabilities—Nada calls Level 5 “unnecessary”—which will be provided by a “non-European, non-Asian supplier.” The car’s long dashboard will also be utilised to deploy “unique human-machine interface (HMI) experiences.” The HMI itself will consist of a large, multifunctional screen with features that change depending on whether the car is in motion or not. Nada stated he was unable to provide further details on the vehicle’s interior at this time. However, *Automotive World* did [discuss the possibilities](#) with Perini and Head of Design Alessandro Serra in October 2022.



Partners and markets

Automotive supply chains, particularly in Europe, are bracing for difficulties, shortages, and price increases [exacerbated by recent geopolitical events](#). However, since Aehra is still in its prototyping phase, Stefano Mazzetti, Head of Purchasing and Procurement, tells *Automotive World* that it is too early for the company to be seriously affected short term. “We will begin serialisation in 2023, tooling in 2024, and then pre-series production in 2025,” he states. “At the moment, it’s more important for us to build strong partnerships with suppliers globally.”



Hazim Nada
Chief Executive Officer, Aehra



Filippo Perini
Chief Design Officer, Aehra





‘Sustainability’ will be Aehra’s watchword during this time. Carbon fibre, which Mazzetti notes will constitute the SUV’s body, was selected for its strong, light, and recyclable qualities. Indeed, the International Energy Agency states that carbon fibre can be recycled up to five times with negligible impact on its performance. Furthermore, using recycled carbon fibre reduces CO2 emissions 85% compared to using virgin fibre, and 50% compared to aluminium. Aehra’s car parts will also be formed using a sheet moulding composite process, which accelerates cycle and production times while also dispensing with the need for high-

temperature/high-emission autoclaves.

Despite looking for external material suppliers, Aehra is also exploring ways to build a strong in-house R&D team. In Italy, this may prove challenging—Nada states that EV-specific expertise is currently underdeveloped compared to other EU countries like Germany. “However, Italy has a big automotive sector that is constantly evolving,” adds Mazzetti. It is the fifth largest in Europe and the industry contributes 8.5% of the national GDP. “That agility and latent know-how is what I’m sure will enable us to find the perfect co-development partner.”



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Our vision is to change the shapes of vehicles, and that idea has been realised in the first instance with our SUV

Changing the shape of EVs?

The Aehra SUV's unique design—spearheaded by Perini and Serra—is only the beginning. Nada reveals to *Automotive World* that a sedan model will follow shortly after the SUV's release, with a 2x2 coupé model coming a few years later.

While Aehra's car emphasises its Italian and European roots, Nada highlights performance shortcomings from high premium competitors in



China and the US as providing the impetus for a global expansion approach. “In terms of sales, we will target the US and selected European countries like Germany, the UK, and Switzerland in our first phase,” he says. “Our second phase includes the rest of Europe as well as China.” The third phase will then encapsulate the rest of the world. In terms of European geography, the company aims to produce 25,000 units annually once released. However, Nada cannot state what capacity for the rest of the world might be.

Aehra’s SUV, states Perini, is “a passion project” that prioritises a “less is more” approach to design and sustainable material sourcing. While the start-up still has a long road to travel in terms of production—a factory has not yet been built or selected—its vehicle signals the exciting possibilities of EV design as distinct from ICE. “Our vision is to change the shapes of vehicles, and that idea has been realised in the first instance with our SUV,” concludes Nada.

Warnings on Tesla stock bubble grow louder

No company is immune from market headwinds, warn analysts. Megan Lampinen hears more



Tesla has arguably become the golden child of electric mobility, breaking new ground with its advanced technology and attracting a devoted following of fans and investors. Sales are outpacing production and should only grow as supply bottlenecks ease. The automaker entered the S&P 500 in December 2020 and its market capitalisation today is larger than the next eight automakers combined.



“Tesla is the world’s most heavily traded stock—and for good reason,” says Oktay Kavrak, Chartered Financial Analyst and Product Strategist at Leverage Shares. “Its visionary leader, who both polarises and galvanises millions across the globe, is the reason why Tesla is always topical.” As a result, the stock has gained over 50% over the last two years. Tesla became the first automaker to have a market valuation pass the US\$1tr mark, which has been scribed by various analysts and different times as ‘crazy’ and ‘insane’.

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Its market capitalisation today is larger than the next eight automakers combined

However, serious trouble may be looming. No company, no matter how innovative or pioneering, is invincible from market headwinds.

Commenting on the company’s Q3 2022 earnings, Alyssa Altman, Head of Transportation and Mobility at consultancy Publicis Sapient, remarked:



Tesla Model 3

“The market will prove challenging [for Tesla] as it has for all OEMs. Inflation is high, energy bills in Europe are increasing and China’s economic slowdown is impacting the rest of the world. The competition is heating up and Tesla will need to work to keep its aura.”

As for its stock, the bubble could soon burst. Today, Tesla trades at a hefty premium in terms of price/earnings ratio and EV/EBITDA (enterprise value/earnings before interest, taxes, depreciation and amortisation), compared to its peers. Kavrak warns that investors have been paying a hefty premium in the expectation that the automaker would maintain its top line growth throughout the coming economic storm, despite rising risks associated with the company’s “excessively ambitious pipeline.”

Concerns

A number of recent developments could spell trouble for the automaker. Among other things, Elon Musk’s purchase of Twitter has had many industry watchers concerned. “The Twitter saga is frustrating for investors as it shows that Elon has yet another company—in addition to SpaceX, The

Boring Company and Neuralink—further diluting his focus on Tesla,” Kavrak tells *Automotive World*.

The strong US dollar also doesn’t bode well. “The resilient global currency could have a negative impact on sales as the dollar has already gained more than 18% this year vs a basket of leading currencies, which translates into lower revenues for US-based companies,” he adds. Notably, Tesla receives more than half of its revenues from abroad.

Kavrak also points to general macro uncertainty, explaining, “Although Tesla makes luxury vehicles, a segment that’s relatively shielded from challenging economic times, its most popular model is also the most affordable one.” The Model 3 starts around US\$46,990 in the US market, compared to a starting price of US\$120,990 for the Model X, US\$65,990 for the Model Y and US\$104,990 for the Model S. “This means that as economic conditions worsen, consumers may put off purchasing a new vehicle,” he cautions.

Then there’s the issue of insider dumps. Since late 2021, insiders have dumped 34 million Tesla shares and purchased none. That raises a red flag

for the company's future. Musk alone sold nearly US\$22bn worth of Tesla shares in 2021. In April 2022 he sold more than US\$8bn worth, followed by another US\$7bn in August. After the US\$44bn Twitter deal closed on 28 October, Musk sold at least another US\$3.95bn worth of Tesla shares. "That could trigger a downward spiral in the stock's price," warns Kavrak.

While insider selling can serve as an early warning sign, it need not always be negative. "It could be due to getting stock option grants and just selling a portion—and this may very well be a small portion of their overall holdings," Kavrak clarifies. "But unless they are strapped for cash, open market sells by insiders could provide good insights into the future of the stock."

Nikola Motors offers an extreme example. Its founder, Trevor Milton, sold a large amount of his stock in the company just days before he was convicted of securities fraud. Truck platooning company Peloton saw insiders sell heavily during the pandemic when the stock surged past US\$150 before plummeting over 95%. These may be rare scenarios, but Kavrak notes that "more often than not if key insiders are selling actively in the open market, they aren't very bullish on the short-term potential of the stock."

Meanwhile, more companies are getting into the EV game with increasingly competitive models. China's BYD in particular is one to watch out for. Such increased competition "will lead to an even steeper uphill battle for Tesla to maintain market share, and likely lead to forced price cuts," Kavrak predicts.

Then there is the 'key man' risk. "People love Tesla because they believe in Elon," he says. What happens if he steps down? "It would have a huge impact on investors' views on the future potential of the company," predicts Kavrak. "Much of the company's valuation is still based on potential developments, like robotaxis. This is unlike Apple and Amazon where there was already a well-oiled machine in place that was simply in need of a supervisor."

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Since late 2021,
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34 million Tesla shares
and purchased none

Advice to investors

Against this backdrop, investors need to be cautious. "If already holding on to Tesla stock, think twice about adding to your positions right now," advises Kavrak. "The stock is down 28% in the last month alone, so we might see a dead-cat bounce as valuations have improved considerably." He points to the quote from American investor and mutual fund manager Peter Lynch, in which he states: 'Insiders might sell their shares for any number of reasons (mostly financial), but they buy them for only one: they think the price will rise.' Musk has not been buying lately.



Images © Motional

Uber and Motional target record robotaxi deployment

Motional offers a deep dive into its latest self-driving project with Uber.
By Megan Lampinen

Motional is powering ahead in its efforts to lead the push for self-driving vehicles. The company, a joint venture between Hyundai and Aptiv, has been working to make driverless vehicles “a safe, reliable, and accessible reality.” Its AI-first autonomy stack is the result of decades of innovation and millions of miles of testing. At the heart of its approach is the Continuous Learning Framework, a cloud-based infrastructure that draws on machine learning principles to make autonomous vehicles (AVs) safer and better drivers with every mile of road time.

Motional’s product offering allows its partners to plug-and-play fleets of self-driving vehicles onto their network. Its focus is on ride-hailing and delivery

applications and it's been working with some big names including Lyft, Via and Uber. The most recent move sees it expanding its collaboration with Uber from delivery vehicles to also include ride-hailing. It's a significant development in that it positions Motional as the first AV company to offer both delivery and ride-hailing services with a key player like Uber.

Over the past few years, Motional has also been working closely with Lyft on a robotaxi service, running more than 100,000 public rides in Las Vegas. Philip Vidal, Senior Director of Business Development at Motional, explains that the Uber agreement will not impact that partnership. In his view, the more partners the better. "We believe that ride-hail networks are critical to scaling driverless technology, and we're proud to be the ride-hailing industry's AV provider of choice," Vidal tells *Automotive World*. "We're the only AV company to have partnerships with Lyft, Uber, and Via, giving us unparalleled access to millions of customers. We anticipate many partnerships in this space as mobility companies around the world recognise the benefits of having integrated mobility networks with AVs."

Delivery vs ride-hailing

Motional and Uber initially announced a partnership on [autonomous delivery fleets](#) in February 2022. In this collaboration, Motional's self-driving Hyundai Ioniq 5-based vehicles have been put to work delivering food orders for Uber Eats in Santa Monica, California. While still early days, Vidal says it is going well: "This was Motional's first

foray into the autonomous delivery space and we've been very pleased with the customer response." He describes the feedback as "overwhelmingly positive" and notes that the partners have expanded to a larger service area, added more merchants, and started laying plans for further expansion. "I think customers value the option of having a driverless delivery," he adds.

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We have to ensure that passengers have an enjoyable experience and don't miss traditional driver touchpoints

So why add on ride-hailing as well? "We have always seen AVs as having the potential to benefit the Uber network, whether through delivery or ride-hailing. We chose to prioritise delivery because it was an exciting new market opportunity in which we were eager to gain experience," explains Vidal. Now that the delivery service is up and running well, Motional is ready to add another angle.

The partners are not publicly sharing the volume of vehicles involved or predicted rides, but they expect this will be the largest deployment of AVs on a major ride-hail network. "The

scale of the service will significantly impact the availability of robotaxis for consumers,” promises Vidal.

To start with, all delivery and ride-hail services with Uber have two vehicle operators present in the vehicle. They are there to monitor the technology and, if necessary, provide support to customers. At some point, though, the aim is to remove them. Starting in 2023, this is exactly what will happen with the Lyft fleet.

Before it begins fully driverless operations, Motional must consider a number of factors. “First and foremost is the safety of our passengers and other road users,” emphasises Vidal. The company has developed a rigorous, multi-year safety evaluation process, as detailed

in its Voluntary Safety Self-Assessment. For example, before beginning driverless operation in Las Vegas, it underwent a two-year safety evaluation process that included an independent assessment and endorsement from safety assessor TÜV SÜD.

User experience

But there’s more to consider than just the technical performance and validation of the driving system. “Beyond safety, we have to ensure that passengers have an enjoyable experience and don’t miss traditional driver touchpoints,” he adds. To solve for this, Motional has developed a suite of user experience (UX) features that allow passengers to interact with

Motional's all-electric AVs have been conducting deliveries with Uber Eats





The Ioniq 5 robotaxi is an all-electric, SAE Level 4 AV powered by Motional's AI-first autonomy stack

the vehicle without an operator being present. The company also works “thoughtfully” with its partners to integrate these technologies, says Vidal. The aim is a seamless end-to-end experience with the familiarity of a traditional ride-hailing trip.

The UX for a ride-hailing use cases will differ considerably from what is needed with delivery services. “Designing a vehicle capable of delivering food and goods requires that we consider the needs of both the end-customer and the merchant, rather than just the rider,” Vidal points out. “And while we may not need to worry about the passenger’s music choice, for example, we do need to accommodate a wide range of food packaging shapes, sizes, and temperatures. For example, transporting smoothies or other beverages is quite different than transporting a couple of large pizzas.”

While there are many differences, the ultimate goal is the same: “We want to provide our customers with a safe,

convenient, and efficient transportation option. We spend a lot of time and energy thinking about the UX so that our customers don’t have to. The experience should be seamless enough that they don’t have to think about the driverless technology at all. That means we’ve succeeded.”

A busy decade

Motional’s agreement with Uber runs for ten years, at which point the industry could look very different from today. “You’ll see a lot of progress over the next decade. AVs will evolve from being a niche technology to a viable mobility solution in cities around the world,” asserts Vidal. As for Motional in particular, it expects to be operating across multiple continents, networks, and verticals by the end of the decade. “Whether it’s people, packages, or pizza, consumers will have regular interactions with driverless technology,” he predicts.

Cost and compatibility challenge ultra-fast network rollout

It is neither straightforward nor cheap to set up ultra-fast chargers. Michael Nash investigates

The aim of ultra-fast EV charging is both to facilitate long distance travel without losing unnecessary time on charging stops and to make EVs an option for people that cannot charge at home or work. That's according to Andreas Mueller, Senior Vice President for Business Line Public Charging at ABB E-mobility. "The faster we can charge an EV, the better it will be for these users," he emphasises. Increased public availability of ultra-fast charging stations will likely result in greater EV adoption, but there are numerous challenges that infrastructure players face as they aim to roll out a network of stations.

Picking up the bill

Construction and installation of EV charging stations differs when considering power options. For ultra-fast charging, stations need to be able to draw greater power from the grid, which requires specific power electronics and cable types, as well as safety and control systems like breakers and contactors for high currents. Mueller also explains that "upstream equipment"—or equipment used off-site—needs to be specific to cater for ultra-fast charging. This includes the switchboard and transformer, while "thicker and higher-rated cables need to be used to connect them to the chargers." It all adds up to a larger financial

investment when building and installing the station, which ultimately has a knock-on impact when the customer receives the bill after charging.

But getting to the point of paying the bill can be a headache. "In general, public charging stations across the EU and US utilise the Combined Charging System (CCS), while the GB/T standard is used in China and CHAdeMO in Japan," says Mueller. "In the EU and US, CCS is well established and makes it possible to connect almost all EVs to a public charger. However, compatibility issues tend to arise more often with the various payment and authorisation options, as well as in some grey areas in the standards or compliance of



various EV and infrastructure manufacturers.”

The frustration is shared by André ten Bloemendal, Senior Vice President, Europe at ChargePoint. “Drivers should have the ability to easily roam between different networks, using their chosen provider to find, access and pay for charging on whatever station they choose. This process is already in full force in many countries, though in some, drivers are forced to sign up to multiple providers to access the full range of public charging available.”

Furthermore, even if a vehicle is compatible with the public charging station, it may not be

possible to use the ultra-fast charging option. “Cars must be equipped with the appropriate technology for ultra-fast charging,” Mueller clarifies, including a collection of microcontrollers, cooling systems, semiconductors and sensors. These technologies add to the price of the vehicle, and although they are increasingly standard amongst OEMs, they are not yet ubiquitous.

“A very fast charging experience also makes the peak power of a charging site go up,” he notes. “If multiple cars together pull 150kW or more, the grid connection needs to be considerably higher. This leads

to more costly infrastructure with bigger transformers, more cabling, and higher utility costs, which ultimately needs to be paid for. The charging costs are therefore typically higher on fast charging locations.”

Smarter battery management

Then there is the issue of battery degradation, associated with the number of charging cycles and speed. This, however, can be combated with the help of smarter systems inside the vehicle. “The battery management system of a car defines how fast a car charges, and does so to ensure long-term

performance of the battery versus the short-term convenience of speed. The best balance depends on the car manufacturer and the related battery technology in use, but will affect different users in different ways,” Mueller states.

Carmakers have been able to offer EVs with greater ranges, Mercedes-Benz currently claiming top spot with its new EQS that can cover 435 miles on a single charge. And although longer range vehicles will undoubtedly help quell range anxiety, Mueller suggests that improved battery management systems will be vital.

Ten Bloemendal agrees, putting the onus on control systems that are installed inside the vehicle. “The

charging speed available depends on the station’s power level, the EV’s battery capacity and real-time updates from the vehicle to the charger. Fast chargers can send a considerable amount of power to an EV, but the vehicle will need to control how much power it takes in and slow down the rate of charge as the battery fills and heats up.”

The average driver may not consider these issues, but ten Bloemendal believes that they will be crucial for fleet operators. By leveraging battery management software together with telematics, he thinks that fleets could optimise utilisation while reducing costs by planning charge times to fit outside of peak grid use.

Pandemic and conflict

Data from the International Energy Agency (IEA) shows that the number of publicly accessible EV charging stations around the world has steadily climbed for several years. This includes a notable increase between 2020 and 2021 from around 1.3 million to 1.8 million, despite what the IEA describes as “a pandemic-related slowdown in construction.” The 500,000 new chargers built in 2021 represent an increase of 37%, which is lower than the 45% growth rate in 2020, while the average annual growth rate reached nearly 50% between 2015 and 2019. However, in 2021, the number of fast chargers increased by 48% compared with 43% in 2020.



IONITY offers rapid 50kW chargers and ultra-rapid 150kW and 175kW chargers

ChargePoint's DC fast chargers can bring the Volvo C40 Recharge, for example, from a 20% to a 90% charge in about 40 minutes, but that's too long for many drivers

The conflict in Eastern Europe may also have an impact on the construction of charging stations, though according to Mueller, it will be a short-term influence. "Many of our markets in Europe have witnessed increasing energy prices as a result of the war in Ukraine over the past months," he acknowledges. "The precise changes may be slightly different by region, but overall it will be an increase in cost for mobility in general, rather than gasoline or electric specifically. We will likely see a temporary impact on EV adoption speed, but we also expect a push for more renewable energy and energy transition in general to reduce dependencies on fossil fuels, which will only accelerate the adoption of EVs in the mid-term."

Accelerating construction

Although there are many factors at play, Mueller highlights two that, if addressed, will help accelerate the construction of an ultra-fast EV charging station network around the world. "Cars need to leverage the available capability of the standards, which will lead to more demand from consumers and then a corresponding growth of outlets that can facilitate this experience. Currently the adoption of cars with high-power charging capability is the limit, not the charging technology itself," he suggests. "The second element to accelerate this change is the affordability of cars containing large batteries with high C ratings."



By 2030, Mueller expects to see a roll out of EV charging stations "along corridors and highways in a similar setup as gas stations today. But on top of this we will also see charging infrastructure in publicly accessible parking areas such as shopping malls and restaurants, with a charging speed tuned to the duration of the stay of customers."

Ten Bloemendal has a different view. He also expects the ultra-fast EV charging network to expand over the coming decade, but thinks the construction of stations will depend on digital tools. "Growth of the charging station network will not follow the path of traditional gas stations, which are conspicuously placed where you "notice" it with your eyes. The search engine for EV charging is a screen—Google Maps, Apple Maps and in vehicle infotainment systems make it easy and efficient to find charging on any given route. This change in how we 'fuel' vehicles will mean that stations will be located in the most convenient places for travel and for the services that drivers want, not necessarily where they are most visible from the motorway."



The road to robotaxis will be an iterative journey

With investor sentiment towards AVs souring, the future of autonomous car-sharing could depend on a far more gradual approach. By Will Girling

Images © Halō.Cars

As of 2022, McKinsey & Co estimates that over US\$200bn has been invested in the global autonomous vehicle (AV) market. However, a rapid sequence of autumn events has industry commentators questioning the sector's ongoing validity.

On 26 October, the IPO for Intel-owned advanced driver-assistance systems (ADAS) firm Mobileye gave it a valuation of US\$17bn, down US\$33bn from 2021's estimate. That same day, Ford and VW announced their joint AV venture, Argo AI, was shutting down and its assets would be divided. The start-up had received US\$3.6bn of investment since it was founded in 2016. VW then sold its car-sharing platform, WeShare, to Miles Mobility just six days later.

The positive reception of GM's and Mercedes' respective ADAS—Super Cruise and Drive Pilot—indicates that development of SAE Level 2 and 3 could still prove profitable. However, Ford Chief Executive Jim Farley's statement that “fully autonomous vehicles at scale are a long way off” indicates the realisation of Level 5 vehicles could be an unattainable medium-term ambition. With [some companies depending on AVs for new ride-hailing and car-sharing business models](#), the market is wide open for a solution that bridges the manned and unmanned driving experience.

A new paradigm

Anand Nandakumar, Founder and Chief Executive of Halo.Cars, tells *Automotive World* that his company can bring the separate threads of CASE (connected, automated, shared, electric) together. A beta-phase car-

sharing start-up currently trialling in Las Vegas, Halo.Cars delivers electric vehicles (EVs) to its customers with no one behind the wheel—they are driven remotely.

“Ultimately, the vision for Halo is to transition the entire world from gasoline-powered vehicles to EVs,” says Nandakumar. “But EVs aren't accessible for everyone: it costs over US\$40,000 to buy one. Furthermore, not everyone has the same access to charging infrastructure for the 95% of the time a vehicle is unused.” In other words, the ownership experience for EVs is currently too restricted, expensive, and inconvenient.

The robotaxi model, he continues, could theoretically address this tripartite problem effectively, yet sufficient AV technology is “15 years away, at least.” As a perception engineering manager at Uber, Nandakumar witnessed first-hand the difficulty of producing a viable, fully self-driving ride-hailing service. His solution was to remove the inconvenience of collecting and parking a car and allow customers to focus solely on driving to their destination. “There's no need to worry about maintaining it or even charging it; they can just get out of the car and walk away.”

In this way, the company hopes to encourage EV adoption by offering a mobility option that is easier and more affordable than private ownership.

Improving operations

Using the 260-mile range Kia Niro as its baseline EV, Halo.Cars adds six cameras, multiple modems and antennas, and a drive-by-wire board to provide the remote operator with a

360-degree view of the road. “There are very few blind spots with this set-up. In fact, there are fewer than if you were actually behind the wheel,” Nandakumar clarifies. Three mobile networks—T-Mobile, AT&T, and

Verizon—combine to maximise 5G connection at all times, giving the Halo.Cars team secure access to steering, acceleration, braking, door locks, and all other necessary functions.

Nandakumar states that there are also significant operational benefits to delivering a car remotely. By removing a driver physically from the car, the same driver can instantly control an entire fleet of cars from a single location. This reduces the operational intensity of moving vehicles across a city while also increasing their dynamic utilisation. “Instead of the cars being idle all the time, we’ll be able to have them constantly on the move,” he says. “And when they require maintenance, the cars can be remotely driven to a service area instead of being physically collected.”

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Knowing there’s a human someone behind the wheel, even though there doesn’t appear to be, is the first step in building trust





The video set-up and driving rig from which Halo's staff can operate its vehicles

Trust in the transition

A March 2022 survey from Pew Research Center found that 63% of US adults would not ride in a fully autonomous vehicle if they were given a chance. Such findings do not surprise Nandakumar, who believes that lack of consumer trust in AVs stems from limited exposure to them. “People haven’t co-existed with AVs; all they’ve known for decades are human drivers. Transitions in behaviour generally happen over time.” Halo.Cars, he suggests, can be part of the iterative process.

The company currently operates in a limited area of Las Vegas (from Charleston to the Arts District). Its fleet is small at the moment, but the plan is to add over 1,000 cars and multiple new cities starting from 2023. By familiarising the general population with seemingly self-driving EVs in a limited context, Halo.Cars hopes that acceptance of both AVs and electrification can develop. “Knowing there’s a human

someone behind the wheel, even though there doesn’t appear to be, is the first step in building trust,” Nandakumar explains. Afterwards, the separate elements of a journey can be gradually automated as familiarisation builds. This is a far cry from the bold claims of imminent Level 5 capabilities quoted from Elon Musk since 2014.

While the general sentiment on AV investment is presently, although perhaps temporarily, dampened, the future prospects for the sector remain positive. If Nandakumar’s analysis is correct, the mistake may have been trying to deliver too much too quickly. Ever since the industrial revolution, automation has served to optimise an already sound process, and car-sharing services will need to walk before they can run. “We want to build a company that has a clear path to profitability without automation,” he concludes. “Adding automation should increase margins, reduce costs, boost scale, and increase accessibility to EVs. That’s ultimately what AVs should be all about.”

Where next for wrong-way driving detection?

These safety systems are becoming much more accurate thanks to LiDAR and could very soon take on a more active role in vehicle control. By Megan Lampinen



Driving in the wrong direction happens more frequently than many people may realise, and can have devastating consequences. Data from the AAA Foundation for Traffic Safety show that there were more than 2,000 deaths from wrong-way driving crashes on US highways between 2015 and 2018. Wrong-way driving usually occurs when a vehicle enters the highway using an exit ramp and can stem from many different causes: driver distraction, intoxication, road detours, poorly designed highway interchanges, a lack of clear signage, etc.

The fallout can be severe. Because these incidents often result in a head-on collision at highway speeds, they are many times more likely to result in a fatality. They may also cause highway to be shut down for hours at a time, impacting local economies.

“It is a very serious problem,” says Jerone Floor, Vice President of Products and Solutions for 3D computer vision specialist Seoul Robotics. The company is pioneering a new take on wrong-way detection (WWD). With sensors mounted on road infrastructure, its system can detect wrong-way vehicles and issue alerts to the driver and the authorities.



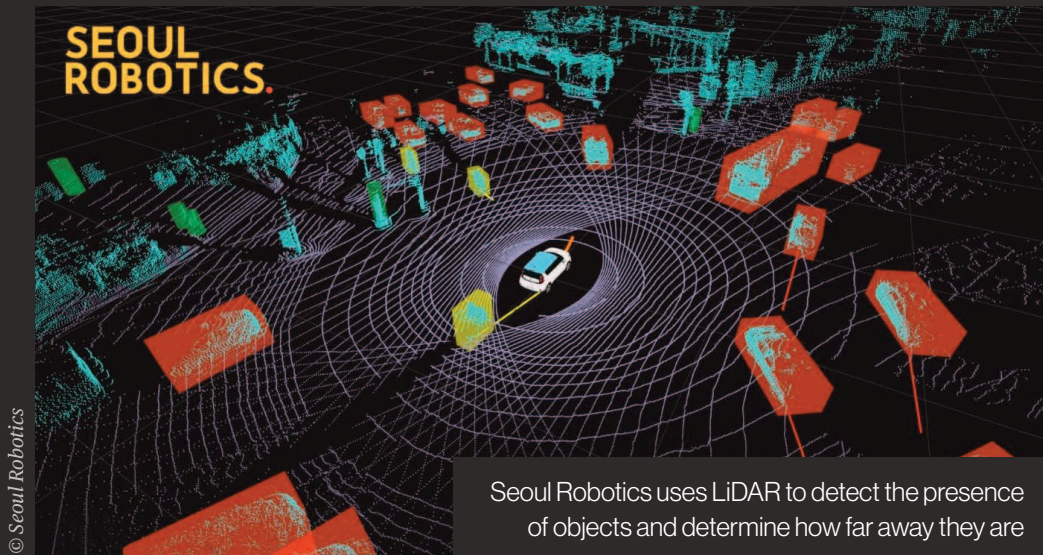
The LiDAR difference

WWD systems already exist today but most of these are camera-based. Instead, Seoul Robotics uses LiDAR to detect the presence of objects and determine how far away they are. “We know not only the movement of each vehicle but also how far away it is and the direction of travel. We have a full 3D picture with x, y and z coordinates,” Floor tells *Automotive World*.

Camera-based systems struggle in darkness or in the glare of the sun, but LiDAR performs as well during

the day as it does at night, and glare is not an issue. Seoul Robotics claims that because it uses LiDAR, its system generates far fewer false reports than camera-based systems.

Floor estimates that some camera-based solutions have an accuracy of 70%, meaning they pick up seven out of ten vehicles driving the wrong way. Seoul Robotics claims an accuracy of over 99%. “In an unofficial test with 100,000 vehicles, we only missed one of them,” he notes. “We have also done dedicated testing with several organisations, where they shut down the off-ramp, physically created



Seoul Robotics uses LiDAR to detect the presence of objects and determine how far away they are

wrong-way triggers and had a car driving the wrong way. We passed with 100% accuracy.”

All the system calculations are performed locally by a computer placed in a cabinet next to the pole where the sensor is mounted. This approach avoids the expense of laying a long fibre connection to a station miles away. “Yes, the LiDAR sensor is expensive compared to a camera, but putting down a fibre cable is a lot more expensive, especially because many highway on/off ramps are not easily accessible,” Floor adds. The installation process can be completed in less than a day. “Somebody essentially drives up with a trailer, puts it on the side of the road and within 30 minutes you’re up and running.”

Preventable

The system, which was developed in collaboration with traffic analyser expert MH Corbin, is trained to filter wrong-way movement at speeds as slow as 5km/hour at up to four lanes deep and at a distance of up to 40m.

In ascertaining vehicle direction, the computer does considerable filtering of the data: is it clean, is there any noise, are there vehicles obstructing each other? Only once the wrong-way movement of the vehicle passes all the filters will it then generate an event.

Once the system determines there is indeed a wrong-way driving event taking place, it issues a series of warnings to the driver via road signs. “In most cases, you can prevent an incident if the driver is warned they’re going the wrong direction,” Floor explains. “Most drivers don’t realise they took a wrong turn until they get on the highway. Once they are on the highway, people panic. They don’t know what to do, and that’s where serious incidents happen.”

The aim is to alert them early. The first warning comes at the end of the off-ramp as it leads off from the highway, where cars may be about to incorrectly enter. It comes in the form of a flashing light or an electronic sign telling the vehicle ‘you are going the wrong way.’ The sign is normally off, but illuminates during

an event. If the vehicle passes this sign there will be a second sign with flashing lights and possibly a siren to get the driver's attention. The last stage is to send a message to a central monitoring station.

A camera is located on the WWD setup and a person will be watching the video, visually checking messages to verify a wrong-way driving incident. They will then call the local authorities—the local sheriff or the police department—to shut down the highway, intercept the wrong-way driver and allow them to turn around.

Where next?

Today, WWD is installed in locations across the US, Europe, and Korea. In most cases, the decision to purchase the technology is made by the Department of Transportation with the rationale that it improves safety and avoids an economic impact. “Money talks,” says Floor. “The sad reality is that the economic impact is what drives much of this. But if you can save the money while saving lives, that's a good thing. There's nothing wrong with that.”

In some cases, a region may not even realise that it has a problem. That was the case in Tennessee, where Seoul Robotics has been working on WWD with the Chattanooga Department of Transportation and the University of Tennessee at Chattanooga's Center for Urban Informatics and Progress (CUIP). “The City of Chattanooga told us we can go ahead and place the trailer unit at a specific off-ramp but warned us not to expect any wrong-ways because there were no suspected issues there. They thought it would just be a demo,” he notes.

“We had two incidents of WWD in one week.” The trailer setup has several benefits. If a city suspects that a particular off-ramp might be a problem, they can simply drive a trailer to the location and let it sit there for two weeks and find out.

Looking ahead, Floor anticipates further iterations of the technology that could provide additional insights, such as monitoring how many cars pass by at any given time of day, what segment of cars are on the road, how fast they approach the off-ramp, or the number of pedestrians walking by. “This is the whole idea of launching a simple solution that solves a very basic problem,” he says. “Once it's installed and everybody has seen it, then the conversation turns to what's next.”

That could involve remote control of vehicles travelling in the wrong direction. Seoul Robotics is currently testing a product that allows for just that. Notably, the vehicle itself doesn't have any sensors on it; all the data comes from Seoul's roadside unit. “Because we can see and we know the full 3D location of each vehicle, we can tell the vehicle where to go,” Floor explains. “Ultimately, our goal is to send a message directly to the vehicle itself when it is found to be travelling in the wrong direction.”

That message would pop up on the dashboard. If the driver doesn't take action, the remote monitor would intervene and stop the vehicle until the driver realises what's going on. “That's the ultimate goal,” he emphasises. “Many vehicles right now are outfitted with brake assist, cruise control and lane-keeping, so we have all the components in place.”

Mobility innovation stalls in Russia

The push for zero-emission, connected and autonomous driving demands international collaboration and big budgets. Megan Lampinen hears more



Russia's automotive sector has taken a huge hit in the wake of its war on Ukraine, the subsequent Western sanctions, and voluntary curtailment of operations by Western companies. Between March and July 2022, new vehicle sales plunged 76% on average compared with the same period in 2021, according to data from the Association of European Businesses. It's a similar picture with vehicle production: passenger car output declined by 85% year-on-year in the March-June period.

“This is in part driven by Western sanctions, which have deprived Russian manufacturers of essential components, and Western carmakers leaving the Russian market after the start of the war in Ukraine,” explains Mario Bikarski, Europe Analyst at the Economist Intelligence Unit (EIU). “At the same time, it's related to declining overall consumer demand as a result of high inflation and lower incentive spend.”

As a whole, Russia's contribution to the global market has shrunk dramatically. Before the conflict Russia accounted for 2% of the global light vehicle market (sales and production). The January-July 2021 period is in line with that 2% annual figure but in the January-July 2022 period that percentage more than halved. “Production in Russia was just 0.8% of the global output over that period, with sales accounting for about 0.9%,” observes Vittoria Ferraris, Senior Director & Sector Lead Automotive EMEA, S&P Global Ratings.

Bikarski notes that the impact on heavy vehicle production has been less severe, but these production lines also face component shortages—

truck production contracted by 32% while that of buses by 14% year-on-year in the March-June period.

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The footprint of Chinese automakers in the Russian market is relatively small but it is likely to expand

The brunt of the impact

Russia's automotive sector depends heavily on imported components and foreign investment, and the entire ecosystem is feeling the impact of sanctions. Most Western automakers have suspended their operations in Russia, while others have stopped exporting to the region. Renault is one of the most exposed to the crisis. “Renault Russia was generating quite a rich cash flow, assembling and selling Renault and Dacia brands in the country,” notes Ferraris. “It also controlled local brand Lada through AvtoVAZ.”



© Lada

Russian production is on a downward spiral

In the wake of the conflict Renault gave up its 68% stake in AvtoVAZ but retains the option to buy it back within six years. According to local reports, Renault’s Russian assets were sold for a token one rouble to the Russian government.

Meanwhile, domestic automakers are struggling to keep their factories running. “Some are looking for options to ensure a steady supply of automotive components, possibly sourced locally or imported from China or India, to replace the ones imported from western countries,” explains Nishita Aggarwal, EIU Automotive Analyst. Others are resorting to manufacturing simplified versions of their vehicles with fewer features.

“The problem has been the embargo and the fact that so much component sourcing was coming from Europe,” Ferraris tells *Automotive World*. “That was heavily disrupted. Some players

stopped production simply because it was no longer feasible.” She warns that a potential crisis in the labour market could be looming, with so many plant closures and brand withdrawals. “Many people will have been left without a job. There is a limit to what the private sector can absorb.”

Asia’s rise

In the meantime, companies could start to rebuild supply chains by sourcing parts from other regions, particularly Asia. Ferraris flags China, India and Indonesia as potential locations from which local manufacturers may seek supply. “Lada’s line-up is not that sophisticated compared to the volume sector in Europe, so I would expect that the procurement remains relatively basic and commoditised. In a way, that’s easier to replace,” she adds.

Chinese vehicle brands may also see an opportunity in the current situation. “The footprint of Chinese automakers in the Russian market is relatively small but it is likely to expand,” predicts Bikarski.

Future mobility

What do today’s challenges mean for the future of mobility in Russia and its readiness for connected, autonomous, shared and electric (CASE) transport? “The pace of CASE development is likely to slow in Russia, owing to the lack of key automotive components and access to new technologies,” predicts Aggarwal. “Collaboration with technology companies is key for vehicle innovations, and the imposition of western sanctions will dampen the scope of such partnerships.”

As for electrification in particular, Russia has long lagged other regions; it doesn’t even make it into EY’s Electric Vehicle (EV) Readiness Index, which examines the top 14 vehicle markets for the arrival of EVs based on supply, demand and regulation. At the moment, EVs account for less than 1% of new passenger car sales in the country. The EIU expects that figure to remain below 10% until the end of this decade. “Russia doesn’t produce any EVs, and western sanctions will further affect EV sales in the country,” adds Aggarwal.

Ferraris also warns that future mobility will not be a top priority moving forward and flags Renault’s electrification strategy as an example. Renault has established itself as an EV pioneer in Europe, but not with the

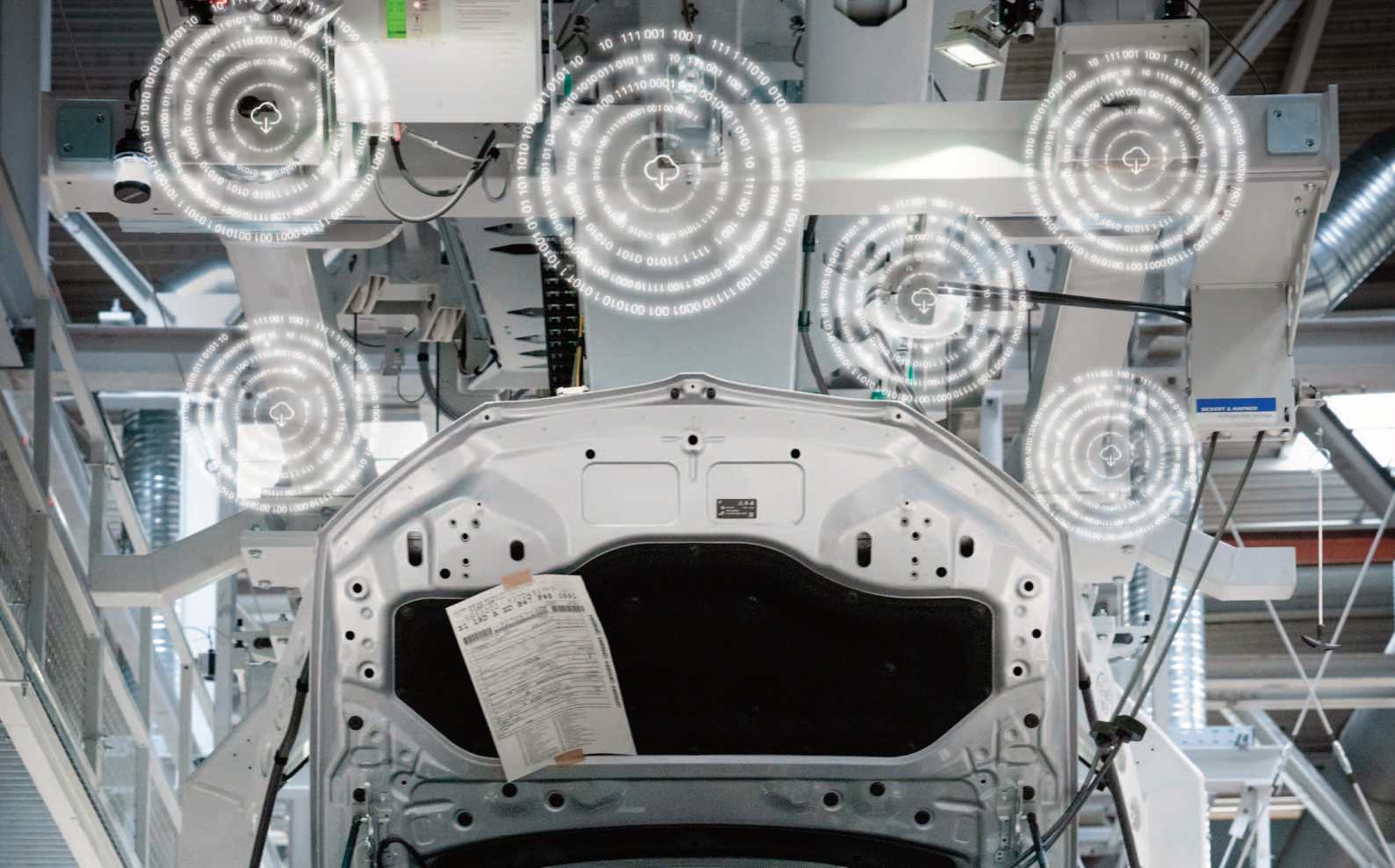
Dacia brand. “The plan was to gradually electrify Dacia, as it’s an entry level brand. At the same time, it wanted to pull Dacia and Lada together,” she says. “Lada accounts for 60-70% of the Russian business, so that tells us the ambition to quickly electrify the brand was really not a concern in that region.”

She also notes that the EV market is heavily driven by regulation, and Russia has been lacking the environmental push seen elsewhere. “In terms of energy and mobility, I don’t think Russia is anywhere near the stage of what we are observing in Europe. It’s a similar case in South America. Brazil is a very interesting market in terms of the volumes, but when it comes to electrification it has a completely different regulatory development compared to other regions.”

Nothing to see here?

While sales and production may gradually rebound in the coming years, Russia is unlikely to become an innovation centre for future mobility. “Reasons to be over-optimistic on the development of the Russian markets are relatively scarce,” asserts Ferraris.

Iran offers one example of what can happen to a market hit with harsh sanctions by the West. “With US President Donald Trump’s embargo it became basically impossible to produce and sell over there,” says Ferraris. “Many of the European brands—especially Peugeot and Renault—were penalised and the Iran market plunged very quickly.” It has not yet recovered to what it was before that. Russia may well follow a similar path forward.



Manufacturing data: too much of a good thing?

Terri Ghio explores the importance of centralised data and interconnectivity, data architecture and eliminating siloed data



Whoever said, “there’s no such thing as too much of a good thing” clearly never looked at manufacturing data historians full of unused data. At the turn of the 21st century, there was a push towards collecting greater and greater amounts of data in manufacturing. Data collection was—and remains—a good impulse, but data collection rapidly outpaced data integration, architecture, and analytics. Today, vast amounts of data are going unused.

The road to data inefficiency

Modern manufacturing abounds with analogue and digital systems. At any given manufacturer, one might find various combinations of ERP, MES, CRM, PLC, and SCADA systems, not to mention home-grown excel workarounds. Each of these systems collects vast amounts of data. However, not all data is equally valuable. Data is only helpful insofar as it can be leveraged for actionable insights which lead to more efficient processes and ultimately positive ROI.

Manufacturers have spent significant investment on various legacy systems, which on their own deliver results. Yet, they’re routinely finding that the ROI falls short of projections. The problem is not the systems; it’s a lack of interconnectivity.

When manufacturing systems are functioning independently, their utility is greatly reduced. Just as a business will struggle without collaboration between employees,

manufacturing systems need interconnectivity to reach their full potential. With the right solution, manufacturers can get the most out of their existing systems, turning silos of unused data into pipelines of insight.

Data integration

The first step to efficient and effective data is rationalising and integrating data in a data rich environment. To do this, manufacturers leverage Industrial Internet of Things (IIoT) devices to gather data from the shop floor. The key, however, is not merely creating a data rich environment, but ensuring that the data being collected is effectively integrated between systems and machines.

Manufacturers need plug and play connectivity between existing machines, workstations, and software systems, whether old or new, manual or automatic. Moreover, mid-size manufacturers face additional pressure to remain ROI positive throughout the journey to Industry 4.0 and data efficiency. To do this, they must optimise what they already have, rather than making costly wholesale replacements which will take years to become ROI positive. By integrating existing systems with Industry 4.0 technology, manufacturers can set a trajectory of continuous improvement as they implement Industry 4.0 in stages as well as immediately proving ROI through key performance indicators (KPIs) such as decreased waste, energy efficiency, increased productivity, and decreased downtime from predictive maintenance.

Data architecture

Data silos, which plague countless manufacturers, are at the core of the data architecture problem. When data is left in a data historian, individual machines, or separate software systems, it becomes siloed. The solution is data centralisation through Industry 4.0. Centralising data into data lakes increases the value of data by creating an ecosystem for cross-communication which leads to actionable insights. Industry 4.0 allows for organisations to preemptively strategise and address issues both before and as they occur, instead of looking in the rearview mirror and reacting to issue when it is already too late.

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Data collection rapidly outpaced data integration, architecture, and analytics. Today, vast amounts of data are going unused

To illustrate, imagine a case of broken machinery. When a machine breaks down, it pays to have the tools close at hand. If a company has the tools, but they're in a different warehouse across the country, they won't be of

much use. The same is true with data. Collecting data that is staying stagnant in one isolated system won't help solve the complex, interconnected problems that manufacturers are facing. However, if that data is centralised in a user-friendly dashboard, manufacturers can leverage actionable information to make better business decisions.

Data analytics

Proper data architecture is the prerequisite to optimal data analytics. Centralised data ensures that all departments have access to the data they need. Far too often various business departments only have access to data from within their department, hindering a chance of the holistic view. With limited visibility, their data analytics have limited utility.

For example, in a typical siloed system, a sales/quality associate might have access to data analytics on warranty claims and product recalls such as how many claims were made, clusters of claims, percentage of products recalled, and so on. With centralised data, this warranty data can be integrated with manufacturing floor data to analyse what was happening on the factory floor when a warranted product was produced.

Furthermore, the warranty data and production data can be correlated to raw material data. Rather than having three separate teams see one-third of the picture, teams can now see the whole picture and make correlations between raw materials, production, and finished products. For the C-Suite, this means no more tracking down fragmented information from disparate sources. Instead, data



analytics is as easy as pulling up a dashboard on a phone, tablet, or laptop from anywhere in the world.

What's next?

In manufacturing, data is cheap, and execution is everything. If today's mid-size manufacturers hope to compete in a crowded marketplace, they can't afford to have large amounts of siloed data. Manufacturing leaders must shift their target from mere data collection to data-informed execution. To do so, this begins with creating data integration at every level of operations, whether between shop floor machines or top floor enterprise

systems. Then this integration must be done with proper data architecture, centralising data into data lakes which ultimately allow for high quality analytics across multiple departments.

Industry 4.0 was once thought of as something nice to have, if you had the resources. Today, manufacturers of all sizes are rapidly realising that Industry 4.0 is necessary for staying competitive in the short term and future proofing for the long term. Fortunately, Industry 4.0 solutions have become more affordable over the years, and now is the time for mid-sized manufacturers to embrace modern technology and reach smart factory status.

About the author: Terri Ghio is President of [FactoryEye](#)

Automakers must reconcile EV ownership with affordability

Electrification is making the entry-point for ownership more expensive, and OEMs must ensure customers are getting their money's worth. By Will Girling

In May 2022, EY's Mobility Consumer Index survey—featuring data from 13,000 people across 18 markets—found that 52% wanted to purchase an electric vehicle (EV). This was the first year that EVs secured majority favour in the Index as an aspirational purchase.

Sentiment has likely been shaped by a number of factors: EVs are a [more environmentally sustainable option](#); a growing number of territories are

[setting sales limits](#) on new internal combustion engine (ICE) vehicles; and [ongoing legislation changes](#) are improving EVs' long-term prospects, to the concurrent detriment of ICE.

However, a major stumbling block to electrification remains affordability. Research by Kelley Blue Book found that the initial cost of a new EV was generally US\$10,000 more expensive than an equivalent ICE model in 2021. Today, with [industry supply chain issues](#)

pushing demand beyond the capacity to supply, prices are unlikely to fall significantly in the short term.

Ownership: an unquestionable good?

Ian McVicar, Senior Director at NTT Data, tells *Automotive World* that the problem of EV affordability goes far beyond sticker price. "It's not just the cost of an EV itself—it's the



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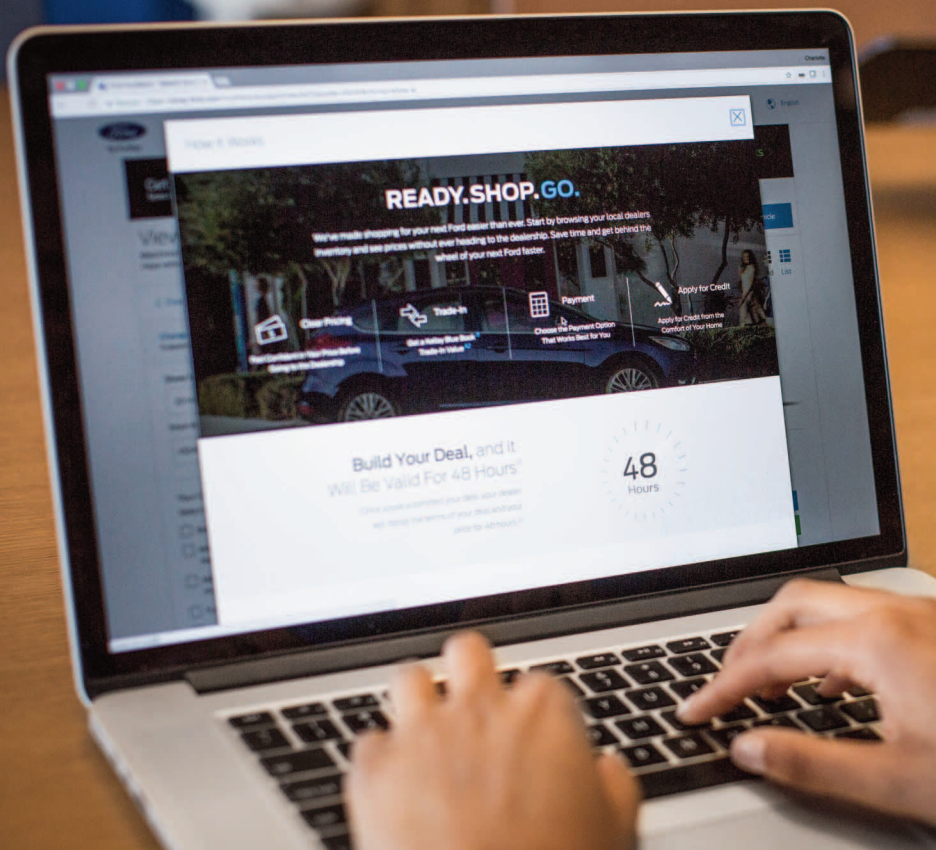
charging, servicing, financing, insurance, and everything else that goes along with it,” he says. In fact, because long-term financing is often required to purchase expensive EVs, McVicar questions whether ‘ownership’ shouldn’t actually be considered merely ‘leasing’ in most instances.

High expenses could precipitate an automotive industry increasingly focused on the shared economy. Companies such as Uber have stated that [electrification will likely boost](#)

[their platform](#), as the regulatory exclusion of ICE will put more EVs on the road and many consumers could more affordably use ride-hailing for their mobility needs. In this respect, McVicar quotes American author William Gibson: “The future is already here, it’s just not very evenly distributed.” What exists in a limited capacity today could prove to be commonplace tomorrow.

The emergence of [subscription-based features](#) in cars, such as

BMW’s heated seat option, also complicates the meaning of ownership in a modern context. “What was underreported at the time is that you can still buy that feature outright,” highlights McVicar. “But this example highlights that the messaging of these new economic models is crucial. Some customers might resent paying more for something they have ostensibly already purchased.” Automakers will increasingly need to ensure that ownership brings tangible value to



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It's not just the cost of an EV itself—it's the charging, servicing, financing, insurance, and everything else that goes along with it

consumers, particularly as higher living costs restrict spending. If they cannot, McVicar questions whether ownership is an “unquestionable good” or if shared mobility models will prove more attractive.

Funding the future

While shared mobility might work as an alternative to ownership in dense urban areas, it is currently less feasible in more rural areas. As such, there will always be customer demographics for whom shared mobility is either undesirable or impractical for their daily needs. Carlos Treadway, Chief Executive of Ford Credit Europe, informs *Automotive World* that the “higher upfront costs” of EVs means that “even more people will choose to purchase or lease their vehicles using

finance in the future.” Therefore, Ford Credit has been exploring new ways of tailoring this to suit each customer’s budget.

The company’s omnichannel ‘Shop & Buy’ customer service experience means that financing can be easily secured from home. This also allows Ford Credit to build a more comprehensive model of each customer’s needs. “Using the connected vehicle and customer data gives us a great opportunity to offer a better or more affordable solution to them. We may suggest a different model or transitioning to an EV to save them money or help grow their business,” he explains. This focus on data also allows for more flexible finance: individual payment terms can be created, and EV-related accessories like home chargers can be incorporated into the agreement.

Ford Credit already offers payment extensions, holidays and reduced payment options to those affected by the European cost-of-living crisis. The company stays up to date with consumers’ constantly evolving needs through detailed feedback monitoring, including surveys, user experience testing, and market intelligence. “This enables us to trial innovative new products. For example, our Options product features Retain—enabling customers to keep their leased vehicle under a new finance contract until they are ready to buy it, trade it in, or hand it back to the business,” he says. This was developed when logged mileages were found to be lower than expected due to increased remote working. “Customers’ needs are changing, and so is the way they want to purchase their vehicles and engage with us,” Treadway summarises.

On 7 November 2022, Tata celebrated the rollout of its 50,000th EV





Tata Tiago EV

© Tata Motors

Democratising EVs

Vivek Srivatsa, Head of Marketing, Sales and Service Strategy at Tata Passenger Electric Mobility, states that his company also recognises this shift. “The Indian market used to be customers contemplating ‘if’ and ‘why’ they should buy an EV,” he explains to *Automotive World*. “That has now moved to a space where customers are pondering ‘when’ and ‘how quickly’ they can purchase an EV.” Similarly taking the shift to electrification as inevitable, Tata has been developing a stable of affordable electric models since 2017. It did so through a three-phase approach.

The company’s first entry was the Nexon EV. Priced at around US\$17,000—above India’s US\$10,000 average for a new vehicle, but still significantly lower than prices in the US or EU—Srivatsa states that the car

was designed to be an attainable EV that didn’t compromise on performance or features. Customers who wanted to spend more could also opt-in for ventilated seats, air purifiers, and more. Range varied depending on the version: the upgraded Nexon EV Max (US\$22,400) has a range spec of 437km (271.5 miles), while the standard model has a scaled back 312km.

Following the Nexon EV’s success, Tata decided to increase affordability and accessibility even further. The Tigor EV (US\$15,260) was the result. “Our business strategy included product, marketing and service interventions to address prevalent myths about EVs in India,” explains Srivatsa. “This was to make customers aware that the barriers to EV adoption in terms of range, charging and the cost of ownership are being addressed.”

Indeed, Tata wanted to demonstrate that EV ownership can be a practical solution to common consumer concerns, such as rising pollution levels and the cost of gasoline.

In September 2022, Tata announced that it was launching a new hatchback model, the Tiago EV, for general release in 2023. Although its anticipated 315km range is roughly on par with the standard Nexon EV model, the Tiago EV's price tag is 41% cheaper at just US\$10,000. "It was time to democratise EV technology," Srivatsa says. "It is the first in its segment to offer best-in-class connected features as standard across all trims, which are usually offered in more premium cars." He also states that the Tiago EV offers two battery pack options and four separate charging solutions, so customers can choose the mobility combination best suited to their needs.

An affordable future?

Tata's efforts to make broadly affordable EVs that still deliver solid performance could become a model for automotive's future. [Citroen recently explored a similar mission](#), although its efforts were primarily focused on pruning inessentials. Given McVicar's assessment that automakers should deliver value above all else in their future offerings, Tata's more

inclusive approach could prove a more popular and successful method for maintaining ownership. Competition between brands on this front may serve to lower prices long term.

However, a greater emphasis on data must still negotiate a delicate balance. McVicar notes that datasets will generally relate to either car performance (tyre wear, mileage driven, etc.) or the driver/occupants

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If occupant data is being provided to third parties, it needs to be shared in a way that provides clear benefits to the customer

In terms of financing, one-size-fits-all solutions are inappropriate at a time when customer needs and situations are increasingly disparate. Ford Credit recognises that leveraging data is integral to financial product customisation and creation, meaning connected mobility trends will likely underpin the growth of electrification. Applied to automotive more broadly, this could open new profit opportunities for OEMs and reduced prices for customers.

(destination, what music they are listening to, number of passengers). "Data monetisation can reduce car prices—much like advertising built into TVs—but these methods are sometimes unpopular with end-users," he states. "If occupant data is being provided to third parties, it needs to be shared in a way that provides clear benefits to the customer." As electrification continues to reshape the industry, squaring affordability with a convenient and valuable ownership experience will be vital.



Images © Vituo

On-demand services are changing attitudes to car ownership

Why wait months for a new car when a mobility service will grant you access to one in just minutes? By Karim Kaddoura

Cities are changing at a pace never seen before, and in the last few years, the idea of car-free areas has been gaining traction. From London's ULEZ and Ghent's 'Circulatieplan' to Birmingham's Clean Air Zone and Brussel's Le Pietonnier, city planners around the world are embarking on large-scale, dynamic social experiments. These are just part of a line of action by political leaders across the UK and Europe to discourage the use of personal cars within cities in the move away from a 20th century, petroleum-based world. But what about when it comes to the individual, to the general public—what do their changing attitudes mean when it comes to private car ownership?

Consider younger generations—Millennials and Gen Z. Growing up in a world of next day delivery, streaming services and fast food, these generations are conditioned for immediacy, convenience, and on-demand services. They are true digital natives. From a very young age, they've been exposed to technology and the internet. Everything is available to them at the touch of a button, and that button is rarely more than an arm's-length away on a mobile device.

Technology has changed the way we do everything, the way we interact, eat, shop, and even sleep these days, and is also the driving force behind the expected change in car ownership attitudes. Netflix style binge watching, dinner at the front door in 20 minutes, being able to book a holiday without ever leaving the couch, these are all facilitating young peoples' extreme need for immediacy and how they see the world.

Purchasing a car can take a long time, between making the actual purchasing decision, placing the order, and extortionate lead times. In fact, with a factory order car it's common to have a lead time of up to three months, maybe even longer.

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Netflix style binge watching, dinner at the front door in 20 minutes, being able to book a holiday without ever leaving the couch, these are all facilitating young peoples' extreme need for immediacy and how they see the world

And for higher end cars, for example any new BMW model, there's typically a lead time of six to nine months. On the other hand, the use of a car is available within a matter of hours in today's society. On-demand and app-based service allow customers to seamlessly book and unlock a range of cars with no queues, hassle, or paperwork, and



Virtuo offers a car-on-demand service

provide quick, easy, and convenient transport methods to this Primed Generation. The question for many boils down to this: why wait close to a year for something that can be delivered to the doorstep in mere hours?

These generations are also now facing a cost-of-living crisis, the worst since the 1950s, and are thus having to become far more financially savvy. Inflation for July 2022 came in at 10.1% - a leap from 9.4% in June and borrowing on credit cards is growing at an annual rate of 12.5%. The cost of owning and running a car is substantial. For most young people (especially those paying big city rent) price is a major factor in any form of decision-making. On average UK car owners lose £1,200 (US\$1,400) a year through depreciation, £500 on insurance, £280 on repairs and servicing, and £144 on road tax. Then there is the additional cost of

financing. The average cost of purchasing a car in cash is £10,511 in the UK, whereas through financing is £15,438—a jump of nearly £5,000. For many older generations, car ownership symbolises freedom and opportunity, while younger generations value the affordability that comes with on-demand car rental services.

What's more is Gen Z's interest in issues pertaining to sustainability and climate change. According to a survey from the University of Bath (2019), 41% of young people aged 16-25 said they were hesitant to have children due to climate change, and 71% said their future is frightening. Younger people are now emerging as the sustainability generations, and private car ownership goes against this. According to government public health research in 2018, air pollution is the largest environmental risk factor linked to deaths in England,



The changing attitudes of Gen Z and millennials have already begun to, and will continue to, impact private car ownership

while research in the European Heart Journal found that poor air quality is likely to take three years off life expectancy.; this is higher than smoking tobacco.

Cars consume a lot of energy before they ever make it to the dealership. Automotive production leaves a giant footprint because materials like steel, rubber, glass, plastics, paints, and many more must be created before a new car is ready to hit the road. These are equally destructive at the end of a car's life. Private cars lead to air and noise pollution, contribute to climate change, and occupy space that could otherwise be used for recreation and green spaces—all in all going against the strong tendency of Gen Z to support the fight against the climate crisis.

Finally, consider the impact on social lives. The most social places in society—parks, squares, pedestrianised areas—are all areas with no cars. To younger generations,

spending weekends with friends, and evenings after work having drinks with colleagues, is an essential part of city living. Private car ownership takes this away to an extent, especially wasteful when you consider that the average car spends 96% of its life idle and depreciating. On top of this, 50% of public space is taken up by roads, eliminating so many of the places which could be used for socialisation. By simply reducing the number of cars on the road, it is possible to reduce the need for roads and parking, and thereby increase the areas in which young people can socialise within cities.

The changing attitudes of Gen Z and millennials have already begun to, and will continue to, impact private car ownership. The demand for immediacy, the extortionate pricing, the impact on the environment, and the effect on social lives all combine to make it so that the future of private car ownership is highly likely to continue its decline going forward.

About the author: Karim Kaddoura is Chief Executive of Virtuo

What does sensor fusion mean for the future of radar?

Gideon Kedem argues that cameras, radars and LiDAR are all vital to autonomous driving



There has been much debate about sensor technology within the automotive industry and the role that cameras, radars and LiDARs will play in the future of autonomous driving. The discussion has centred around the cost and viability of each sensor type, prompting some automakers to move away from radar and LiDAR solutions in favour of camera-based autonomous technology.

The reality is that each sensor type has its own strengths and weaknesses, and all three technologies are vital to the advancement of autonomous technology. Cameras excel in reading street signs and classifying objects but are limited in poor weather conditions. Radars provide accurate measurements of speed and distance and excel in poor weather but cannot read

signs and struggle with traffic lights. LiDARs are highly accurate at measuring objects but are expensive.

While the use of radar in the automotive industry dates back to the 1980s, radar technology has been the subject of significant debate for years. That's because legacy vehicle architectures limit the amount of data that radars can transmit to the CPU.

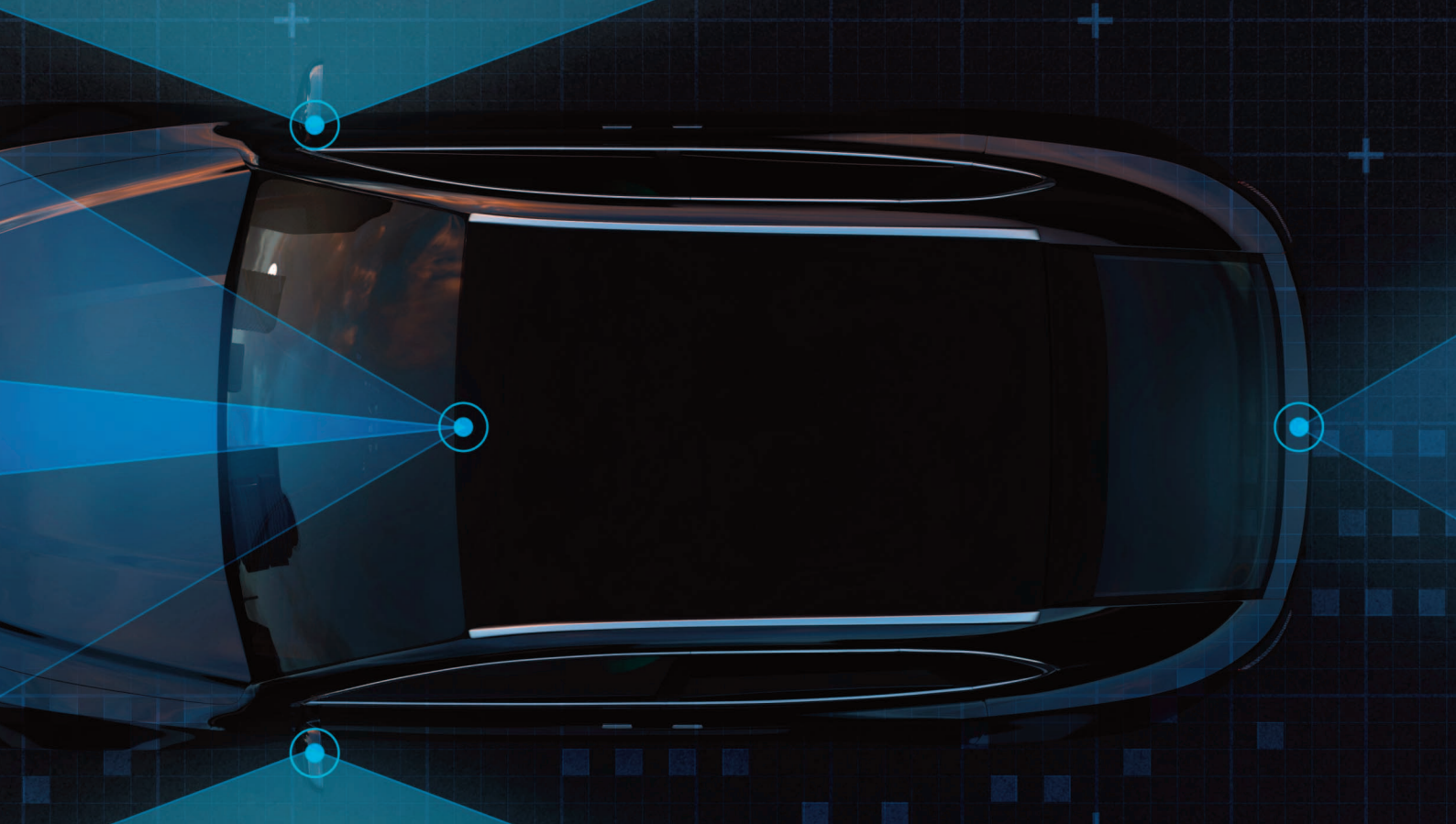
Does this mean the end for radar within automotive design? Not necessarily.

Radars generate massive amounts of data, but existing links simply do not offer sufficient bandwidth to support the transmission of raw data from radars to ECUs. This has forced radar manufacturers to dedicate local processing capabilities within their radars themselves. From a system

perspective, this is sub-optimal as there is no single ECU capable of receiving all the raw data to make a robust decision based on it.

For radar manufacturers to make inroads in autonomous systems, they should transition from this architecture—where the radar and ECU are coupled at the edge—to a satellite architecture. This would move the data processing to a more centralised location in the vehicle, enabling an ECU to access raw data from multiple sensors. The more raw data processed by an ECU, the more accurate the decision can be.

This follows the trend of sensor fusion taking place in the automotive industry, which enables a vehicle's central computing unit to account for various radars, cameras and LiDARs—each of which have their own strengths and



weaknesses. Sensor fusion has the potential to significantly lower complexity and costs in this era of software defined vehicles, while helping cars make safer decisions. Centralised processors in the car can extract much more information from raw data using AI and machine learning techniques, which are harder to implement when processing the data from each radar sensor locally. With a significant number of software companies developing such algorithms, this can enable even higher accuracy and performance.

The satellite radar architecture has other advantages. By removing heavy local

processing from the sensor unit, radars will become much more power efficient, as well as less expensive. Power efficiency is a top priority for OEMs as, with the electrification of the engine, power consumption by the various devices in the vehicle has a direct impact on the driving range of the vehicle. Reducing costs is also important because radars are usually located in vulnerable places within the vehicle that are susceptible to impact and damage.

Satellite architecture requires the tunneling of raw data at high bandwidth and low latency between the host processor and the remote

sensors. This is the type of high-speed connectivity solution that the [MIPI A-PHY standard](#) aims to achieve. For the first time, the industry now has a streamlined, standardised solution to send high bandwidth raw data from radars to a central ECU.

All sensor types will play a vital role in enabling the next stages of autonomous driving, creating less uncertainty around the navigation environment. Centralised processing has the potential to vastly improve the current implementation of various sensor solutions, and this is where radar will continue to play a vital role moving forward.

The opinions expressed here are those of the author and do not necessarily reflect the positions of Automotive World Ltd.

Gideon Kedem is Senior Vice President and Head of Automotive at Valens Semiconductor

The Automotive World Comment column is open to automotive industry decision makers and influencers. If you would like to contribute a Comment article, please contact editorial@automotiveworld.com



Euro 7 highlights economic vs environment debate

While less stringent than many feared, small cars could still see a big price hike from tighter emission regulations. By Megan Lampinen



The industry has steadily been moving towards cleaner, more efficient car and truck engines, but improvements don't come cheap. Within the trucking sector, the shift to the upcoming Euro 7 emission regulation is expected to boost costs for buyers by 2-5%, compared to Euro VI models. That's based on an assessment by the International Council on Clean Transportation (ICCT). Based on an initial range of projected proposals, ICCT researchers concluded that the incremental costs of meeting the upcoming standards compared to a typical Euro VI-compliant emissions control system could be between €1,500 and €4,700 in 2025, rising to between €1,400 and €4,300 in 2030.

Here comes Euro 7

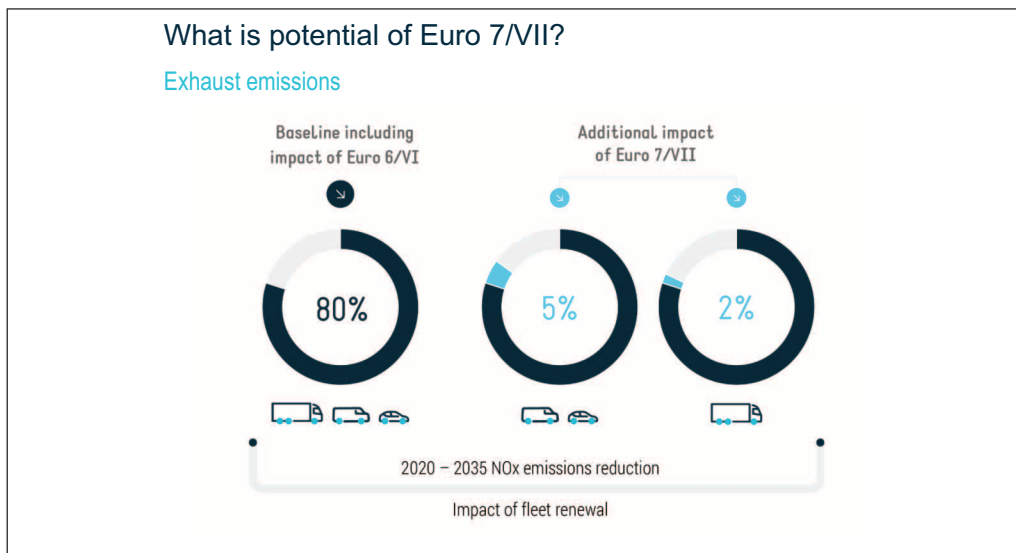
With passenger cars, the price impact of Euro 7 could prove more segment specific. The proposal replaces the previously separate emission rules for cars/vans (Euro 6) and trucks/buses (Euro VI) under a single set of rules. Small, entry-level vehicles are much more sensitive to expensive upgrades than bigger, pricier models. When those upgrades are mandated by new regulations, some buyers will inevitably be pushed out of the new car market.

Europe is moving towards an electric future, but along the way it wants to clean up its internal combustion engines (ICEs). The European Commission (EC) has been mulling a range of proposals for the upcoming Euro 7 standard, which is expected to take effect around 2025. Its final form was unveiled on 10 November 2022. While the EC took a more cautious approach than many expected, it

introduces more stringent limits, addresses new pollutants and extends the stated testing conditions. "That will make life quite hard for standalone ICEs," says Pedro Pacheco, Senior Research Director at Gartner.

Notably, some of the additional cost will be passed along to consumers. "This is going to definitely raise average prices of new models coming to market," he adds. The timing could not be worse. Statistics agency Eurostat reports that the annual rate of inflation in the eurozone recently reached a record high of 10.7%, surpassing the predictions of market analysts. "The economic component is now more important than before due to an impending economic crisis," Pacheco tells *Automotive World*. "This means that heavily favouring the environment would create more economic difficulties for some carmakers, which will have a lot of macroeconomic difficulties to face in the foreseeable future."

Indeed, the final proposals reflect this. For example, the NOx limit for gasoline cars remains unchanged from Euro 6 at 60mg/km, though for diesel it will be lowered 25% from 80mg/km. "Looking at the latest announcements, the definitive targets seem less ambitious than initially expected," Pacheco observes. "This is clearly a reflection of the current economic environment where inflation and fear of a major recession may have made the EU less daring than initially expected. Even so, there are now tyre and brake particle emission rules that introduce new demands. The latter puts an extra burden on EVs where, despite not producing tailpipe emissions, their higher average weight and torque should lead to higher tyre particle emissions."



ACEA has serious concerns about the EC’s proposal for new pollutant emission standards

Restrictive

Sales of new ICE vehicles in Europe will not end until 2035. So, in theory, Euro 7 may not be the last emissions standard for gasoline and diesel. But in practice, warns Pacheco, it could become “so restrictive that it will make it quite hard for carmakers to commercialise standalone ICEs, meaning those models without any form of electrification.”

While sticker prices are rising, certain brands will take a harder hit. This includes those that have been more sluggish in making the transition to electrification, especially in the lower segments, which are more price-sensitive. For instance, the number of battery EVs, plug-in hybrids and hybrids in Europe’s B and A segments is extremely low. “It is also one of the key reasons why several automakers are withdrawing from the A segment and, in some cases, the B segment in Europe,” adds Pacheco. “In the end, the whole financial formula will be heavily squeezed and, for OEMs that are behind the electrification curve, it’s a choice between losing volume or losing profit.”

For consumers, that trend could mean much less model choice within the lowest vehicle segments, especially the A segment. “The drop in volume will be more visible in A and B segments, as usually these are the vehicles most frequently chosen by frugal buyers,” he observes. “However, as prices of those vehicles increase, those buyers may have to rethink vehicle ownership altogether.”

With plenty of warning ahead of the coming Euro 7 standard’s implementation in 2025, and expected price hikes, there may be an element of a pre-buy rush. However, Pacheco does not expect it to be significant, since the process will be gradual: “Not all car models will transition at the same time to Euro 7. It is likely that some carmakers may extend product lifecycles to keep selling ICEs as well. But, of course, we can’t exclude the fact that some more conservative consumers would take their last chance to buy an ICE, even if this won’t represent the majority of shoppers,” he notes.

Those brands with the highest percentage of electrification will be much better prepared for what's about to come. However, Pacheco cautions that 'electrification' in this sense covers hybrids but does not include mild-hybrid setups. "Several hybrid models might make it past Euro 6, but mild hybrids are far less likely."

Is it worth it?

The pressure from environmental groups is fierce and warnings from climate scientists are stark: the industry will inevitably move towards increasingly tighter emissions requirements. The challenge of setting that next limit was evident in the frequent delays in the EC's proposals. The European Automobile Manufacturers' Association (ACEA) tells *Automotive World* that the delay "shows the difficulty in determining how such a policy should be sensibly framed alongside CO2 targets that are driving the push to zero-emission vehicles."

ACEA represents the region's main vehicle producers and claims it serves as "the voice of the EU automotive industry." It has long expressed concern that the move towards a cleaner future is not being supported by government policy. It has also raised concerns about the efficacy of the Euro 7 proposals, claiming that recent studies have proven that the renewal of the fleet with the latest Euro 6 vehicles—alongside the electrification of new vehicles—would deliver an 80% reduction in road transport NOx emissions by 2035 (compared to 2020). By contrast, according to ACEA, even the most stringent Euro 7 proposed scenarios would reduce road transport NOx emissions by less than a further 5%

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While the EC took a more cautious approach than many expected, it introduces more stringent limits, addresses new pollutants and extends the stated testing conditions

from Euro 6 for cars and vans, and by about 2% for trucks.

"Unfortunately, the environmental benefit of the Commission's proposal is very limited, whereas it heavily increases the cost of vehicles," states Oliver Zipse, ACEA President and Chief Executive of BMW. "It focuses on extreme driving conditions that have hardly any real-life relevance." An ACEA spokesperson tells *Automotive World* that "the industry has been calling for an approach that is not only effective in terms of results, but that is cost-beneficial, while also addressing the huge challenges of meeting future CO2 targets. Vehicle manufacturers are going full-course ahead with the goal of carbon neutrality—it would be counter-productive to take away investments from this."

As charging times drop, battery tech must evolve

The CELERITAS project aims to deliver an 80% charge to EVs in just 12 minutes.

Megan Lampinen hears more

Car drivers have become accustomed to a rapid refuelling experience with gasoline and diesel engines, but it's not been easy to replicate that with electric vehicles (EVs). Charging times vary widely depending on the size of the EV battery and the speed of the charging point, but can range from 30 minutes to 12 hours. In the UK, fluid expert Castrol and battery specialist Sprint Power are working together to develop ultra-fast charging cells and battery packs for battery electric vehicles (BEVs) and fuel cell hybrid electric vehicles (FCHEVs). The aim: to deliver an 80% charge in just 12 minutes.

“After vehicle range, ultrafast charging is the next step in knocking down consumer barriers,” says Steve Doyle, Sprint Power’s Chief Technology Officer. With most EVs now offering around 300 miles of range, the biggest consumer concern becomes charging time. Nobody wants to spend a couple of hours mid-trip charging; they want the equivalent experience to filling up with diesel or gasoline.

The partnership is the result of the Birmingham-based project CELERITAS, which is led by Sprint Power. In addition to Castrol, other consortium partners include BMW, battery cell specialist AMTE Power, Silicon Carbide wafer foundry Clas-SiC and Eltrium, a specialist in electrical harnesses and energy storage. A big focus is around BMW’s future battery specifications and requirements, and each partner contributes its own area of expertise and innovation to the battery platform. The aim is to build prototype packs for both a BEV and a FCHEV with the technology.



Castrol fluid analysis

Design and testing challenges

Sprint has been working on battery systems for both vehicle setups that integrate all system electronics and incorporate multiple charging protocols to save space and weight. These systems also include an integrated 800V to 14V DC/DC converter, an 800V battery management system, and direct cooling capabilities. Castrol's ON EV Thermal Fluid plays a key role here—it has been formulated specifically for direct cooling applications to ensure these battery systems can be charged more rapidly and offer increased performance and protection.

“With ultrafast charging, thermal management becomes very important,” says Marc Payne, Senior Research Manager for EV Fluids at Castrol. “You need a good thermal environment around each of those individual cells. Maintaining a certain temperature range can help ensure that the battery pack lasts the lifetime of the car. On the safety front, you want to make sure that the cells don’t overheat and go into a thermal runaway event.”

Castrol’s work on the project involves testing to demonstrate the benefits of the thermal management. Developments are still ongoing but Payne says early results are



encouraging. “We’ve done a puncture test with a nail in a cell that goes into thermal runaway,” he explains. “Some of the tests we’ve done have other cells in close proximity to the one that’s gone into thermal runaway, and our results show that dielectric fluid can prevent a thermal propagation event.”

The project is also developing a specific cell design to cope with the high charging rating (C-rate) with a view of reducing the effects of thermal heating. This area of responsibility falls to project partner AMTE Power, but all consortium partners work together on an optimised overall design. “It’s not like the design of the battery unit and

all the electronics has been done and then there’s an afterthought of putting the fluid in afterwards,” notes Payne.

The power of the consortium

Among the most important areas under development have been determining the best spacing between the cells and the right volume of fluid, as well as how the fluid flows around the cells. From Castrol’s perspective, materials are an important factor. “We needed to have some critical conversations up front to understand the materials that were



With ultrafast charging, thermal management becomes very important

going to be used in the battery pack,” says Payne. The fluid is in contact with many of those materials and Castrol needed to conduct compatibility testing early on. “It might be we have to review plans for a specific material, choosing something with similar properties but that will be compatible,” he adds.

For Doyle, packaging was a tough nut to crack. “Pack height is always a challenge, because you’re trying to fit more stuff into the space that you have,” he notes. He also flags the challenge of finding commonalities between the FCHEV and BEV packs, adding: “It’s not always easy to know where to compromise and where not to. That’s probably one of the hardest decisions that the guys have been making.”

Despite the challenges, the partners highlight the productivity of the teamwork and its impact on the project’s success so far. “This approach is the way forward, because it results in an optimised design,” insists Payne. “The aim is to reduce charging time, in this case to 12 minutes or less. We set ourselves quite a tough target, and only by working together can we achieve results like that.”

Where next for ultrafast charging?

The CELERITAS consortium is just one of many teams working to advance ultrafast charging. While it has made promising advances in its first year, Doyle believes there are “always opportunities to improve what you’re doing.” After the technical challenges around reliability and consistency, he flags a commercial challenge around the user experience: “Once you get the technology into the vehicles the key is to achieve consistency across the grid in terms of how the vehicle interfaces with various charging systems and how consumers pay for their electricity.”

Looking ahead, Doyle expects ultrafast charging to start with the premium segment and gradually make its way down the price scale. “As with all new technology, the price comes down as it grows and starts to penetrate wider markets and applications.” Payne echoes this, adding: “It has to have that mass market application. If you can build convenience into these vehicles, it will cause a step change in the uptake of BEVs going forward.”



Images © HERE Technologies

Location data: the keystone of the software- defined car

**HERE Technologies' CPTO outlines
the mapping evolution
underpinning the shift to an
automated and electric future.
By Megan Lampinen**

The rise of the software-defined vehicle heralds an age of electric, automated and connected driving, with the user experience shaped by the digital cockpit. These elements could offer unprecedented levels of safety and convenience while slashing the sector's carbon footprint. However, they also place unprecedented demands on location-based software and data.

Maps with real-time granular insights about routes, drawing on artificial intelligence (AI) and machine learning (ML) to process all the necessary data points, could accelerate the commercialisation of conditional autonomous vehicles and spur the arrival of fully autonomous vehicles. At the same time, electric vehicle (EV) drivers will need reliable information on charging point locations, specs, pricing and availability if they are to overcome range anxiety.

HERE Technologies has been actively transitioning from a mapping provider to a platform supporting all location use cases. Its Chief Product & Technology Officer Giovanni Lanfranchi believes that location is the number one element for a software-defined vehicle's success. "We have kicked off some pretty key transformations in order to be ready [for the software-defined car] with far more than just a map," he tells *Automotive World*.

What does the push towards a software-defined system mean for automotive location data, and specifically for HERE?

Multi-sourced location data is a key element for the software-defined vehicle, which requires a level of precision an order of magnitude up from the maps we as people use to navigate. We can automatically ingest—in real-time—several sources from the physical world and then conflate the raw data to produce one single semantically consistent digital representation of reality. The other important characteristic for location data is low latency, so all these processes are completely automated and performed through algorithms. A software-defined vehicle with a high level of autonomy requires a real-time representation of reality.

How does HERE stand on both of these metrics at the moment?

Our platform has around 500 million kilometres of vehicle probe and sensor data coming in every hour. In terms of latency, we can update a self-healing map with changes in the real world—such as road works or a change in the lane structure—within a matter of minutes. We can produce a map for an entire continent in less than 24 hours, starting from raw data.

On which tools do you draw to achieve that level of freshness?

We are extensively leveraging AI and ML techniques at multiple stages. It is very much a multi-source and multi-dimensional statistical set of problems we face. Let's imagine you have a set of sources—sensor, satellite and probe data—and you need to build a set of roads. These three sources give you some information but they may have different levels of precision, age, or accuracy for a particular element. At the end of the day, you need to know where to draw your lines. You also need to provide a confidence indicator for automakers, because it's never black or white. So, we have heavily invested in AI and ML, and we have the best data scientists.



Giovanni Lanfranchi
Chief Product & Technology Officer,
HERE Technologies

How big is your team of data scientists?

There are more than 150 specialists with AI and ML skills for map making working on this content factory alone. Across the platform we have almost 1,000 people with skills in these areas.

Have you been working with automakers on this wider map-making transformation?

We are working in close partnership with some key OEM partners and hope to tell the world more about what we have been doing together in the months ahead. In fact, it was during workshops that we identified the importance of producing one single, semantically consistent representation of reality. This is very important for the software-defined car.

Can you flesh out what ‘semantically consistent’ means in terms of mapping?

We want to be sure that when the passenger sees a map with a curve, the autonomous driving system sees the same curve with the same level of representation of reality. Traditionally, the in-vehicle infotainment (IVI) requirements are handled through one set of location maps but the autonomous high-definition map draws on a different set of schema. It is left to the automaker to mix and match what is important from an IVI user experience and what is relevant for a Level 2+ or Level 3 autonomous driving system. This brings additional complexity to the OEM and has a lot of user experience drawbacks.

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In order to have a software-defined car you need to have a software-defined map

Is this where your Map Object Model (MOM) comes in?

With this we have built a model of the world that is not just a representation of reality, as many competitors have, but that also reflects the relationships across the various entities. It’s semantically linked.

If a software-defined vehicle is on a bridge, there is a semantic attribute around the elevation, so the algorithm understands what type of driving policy is needed. We have achieved a semantic, consistent representation of the world, with the linkages, the arrows across the entities defined and updated in real time. This is extremely helpful for automakers from a safety standpoint. For example: about 60% of the speed limits in Europe are implicit; there’s no sign, but because you are near a school, you know what the limit is. These semantic relationships are captured in real time in our MOM, which is a future proof and extendible unified map content data model.

Generally speaking, how do you approach any gaps that may arise in terms of the data you gather?

We are able to forecast where we may have some data gaps and specifically go to an area to acquire—always in real time—more data to fill the gap before it becomes evident. This is what we qualify as campaign management.

‘Digital cockpit’ has become a buzzword today. How are you helping reduce the burden on OEMs as they pursue this vision?

We have developed a plug-and-play Lego block approach that enables OEMs to build the digital cockpit experience in a flexible way by combining a set of available building blocks. Or they can simply build on top, leveraging elements from a heterogenous ecosystem but retaining some level of IP and differentiation. For instance, we have an agreement with parking management company APCOA, which provides certain building blocks that an OEM can insert. Essentially, it provides details



on an end-to-end parking experience including payments.

What about electrification? How does map data need to respond to the growing number of EVs on the road?

We are investing heavily around electrification and are aiming to be the world's leading supplier of location data for EVs. We are looking at both static and dynamic attribution around charge points, including the pricing, discounts on offer, and power levels of stations. We have also developed a set of EV range services, taking range prediction up a level by incorporating details on vehicle speed, number and degree of curves in the road, slope of the road, and traffic conditions, etc.

We have worked on this strategy in collaboration with eight OEMs, and received positive reviews from all of

them, especially on some use cases such as occupancy. EV drivers want to know whether there will be a place free for them once they arrive at a charge point, if all the chargers are working, if a specific location is compatible with their charger, and so on. We are doing these services not just for passenger cars but also commercial trucks.

Where are all of these advances taking HERE and its location data offering?

In order to have a software-defined car you need to have a software-defined map, which is basically what we have built over the past two years. This gives us an advantage not just in terms of speed but also in terms of quality and transparency, as the customers can see—attribute by attribute—the level of accuracy we provide.

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