Nio’s soft-sell to shake up Europe’s premium EV market

Nio brings fresh customer approach to Europe | Lightyear and Aptera bet on solar EVs | New Territory to harness the metaverse in UX | Asian brands see opportunity in Russia | Nikola takes control of its battery destiny
IN THIS ISSUE

04 Nio’s soft-sell to shake up Europe’s premium EV market

10 Solar EVs could provide freedom from the grid

16 The metaverse is just the start of in-car UX

20 West’s withdrawal from Russia opens opportunity for China

24 Is it possible to manufacture EVs both domestically AND affordably?

28 Nikola Motors: “We are in control of our battery destiny”

28 LiDAR sensors can help build AV market growth and trust

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NAIAS legitimises air mobility’s place in automotive 

The Citroën ol: a lab on wheels for sustainable mobility

How to turn EVs from grid threat to balancing opportunity

Predictive maintenance pivotal to electric fleet success

Snapshot on Rastatt: fluid handling in the EV age

Perception technology shapes the evolution of the cockpit

E-mobility puts pressure on project timing and cost KPIs

Cover image courtesy of Nio
Nio’s soft-sell to shake up Europe’s premium EV market

The founders of this EV disruptor speak to Megan Lampinen about their global approach to customer satisfaction
Aim for top quality products and a great customer experience, and the sales will follow. That’s the thinking of Nio’s founders. The Chinese electric vehicle (EV) start-up has been slowly building its presence at home over the past few years and in Q2 2022 led the sales charts among domestic EV start-ups in its home market. But China is just the beginning as Nio has its eye on a global footprint. The team draws on individuals from more than 40 different countries and regions across the world, and by 2025 it wants to have a presence in 25 countries.

At the same time, China and its notorious air quality issues were central to William Li’s initial vision. Founder and Chief Executive Li is often referred to as China’s Elon Musk, and has a similar background as an internet entrepreneur. Looking out of his living room window one November day in 2014, he was dismayed to realise he couldn’t see the building across the way due to China’s thick smog. Nine months later, Nio was founded and work to flesh out an eco-friendly, customer centric business plan had begun. “That was the beginning of our story,” Li told media at the Nio Berlin ‘A New Horizon’ launch event.

The horizon is highly symbolic for the company and is a central feature in the brand logo. Here, the arch represents the horizon and an upside down ‘v’ beneath it the road leading there. “The horizon always symbolises hope and a new beginning,” explained Li.

**A good time for Europe**

While EVs could represent a new beginning for the planet as it faces increasingly urgent air quality and environmental concerns, Nio is also in the midst of its own new start in Europe. The expansion kicked off in Norway in September 2021 and is now advancing into Germany, Sweden, the Netherlands and Denmark. Here, consumers will have choice of three all-electric, highly intelligent models—the ET7 flagship sedan, the EL7 SUV and the ET5 mid-size sedan. Deliveries start with the ET7 later in October. Unlike most other players in the battery-powered segment, Nio offers both battery swap and battery charging, with options to upgrade the battery as and when required.

“The European car market has been stable over the past few years and penetration of EVs is increasing rapidly,” commented Lihong Qin, Nio Co-founder, Director and President, told Automotive World. “We see a big opportunity here and think it is a good time to enter the market.”
Qin was speaking from Nio House Berlin, a brand experience hub in the heart of the city and a central part of its direct-to-consumer model. It fits in with the wider brand strategy that goes beyond the car to include everything from clothing and handbags to porcelain and wine. The Nio Houses serve as a vehicle sales and showcase hub as well as a lifestyle space for owners. There are more than 70 such Houses in China and the first European one opened in Norway in 2021. The Berlin location is almost ready to open its doors and will soon be joined by similar centres in Hamburg, Frankfurt, Düsseldorf, Amsterdam, Rotterdam, Copenhagen, Stockholm, and Gothenburg.

In tackling continental Europe, Qin suggests that Germany is a natural starting point due to the size of the market. It’s also a stronghold for premium models and home of market leaders Audi, BMW and Mercedes-Benz. EV rival Tesla has also been drawn to Berlin, where it operates not only sales outlets but also a Gigafactory just outside the city. Qin is keen to stress that Nio’s launch plans are completely unrelated, joking: “We set up our headquarters in Shanghai eight years ago and Tesla chose that as a manufacturing base. Maybe it was following us!”

“We don’t want to force a user to buy an EV. Instead, we improve ourselves and our offering.”
He is hesitant to admit that Tesla or the German Big Three are direct competitors, side-stepping the issue by insisting that competition is not Nio’s focus: “The car industry is not a case of ‘winner takes all’. When shopping for a car, consumers will compare different products at a similar price level. Products from BMW and Tesla will probably be considered along with ours and we think our offering is competitive, but our top priority is to stay true to our business philosophy. Our biggest competitor is ourselves.”

Learn along the way

With one year in Norway under its belt, Nio has some European experience on which to draw as it expands on the Continent. One of the biggest lessons so far, says Qin, is to acknowledge regional requirements: “In no way can we undervalue the differences of users but we also need to pay attention to their commonalities, regardless of cultural background. Everyone wants to be cared for, to pursue simplicity and to get rid of anxiety and trouble.”
This is where the corporate principles of honesty, care, vision and action come in to play. They are the foundation of its design strategy and product engineering. “Design is a way to express who you are, what you want to become, and what you believe in,” Andreas Nilsson, Nio’s Design Director, told media. Nowhere is this vision made clearer than in the Eve concept car, first unveiled in 2018.

Designed for SAE Level 5 automation, its interior resembles a comfortable living room. “Autonomous driving frees your time by also making cars safer,” Nilsson added. “With smart cabin technology the car becomes a second living space. AI technology will transform cars from cold machines into friendly companions.” In this way, he suggests, it ticks all the boxes of Nio’s corporate principles. The current model line-up incorporates a sense of this vision with a hefty dose of partially automated driving and AI voice assistant Nomi.

Most importantly, perhaps, is management’s concession that it does not yet have all the answers and will take a flexible approach moving forward. “A company should be humble and willing to make changes for users in different places,” Qin noted. Its sales model is a case in point. In Norway it offers only direct sales, but elsewhere in Europe consumers will be limited to a subscription model. That’s mostly down to Norway’s unique taxation system, which results in a low leasing levels. But that approach could change depending on feedback. “We are willing to listen to consumers,” Qin added. “It is good to have different models to try things out and see what users like. If users require it we will make some changes.”

Attract buyers, don’t force them

When Li first looked out the window on that smoggy day back in 2014, he decided to take action. But what represents the successful completion
of that initial vision? “As long as we provide good products and services, with an experience superior to that of gasoline or diesel, users will naturally choose a smart EV,” he told Automotive World. “If enough drivers do that, they will also naturally make a contribution to environmental improvement. We don’t want to force a user to buy an EV. Instead, we improve ourselves and our offering.”

That demands investment, and Nio has been busy bolstering its European base as the next chapter in its global push. In July 2022, it created the Berlin Innovation Centre to develop technologies related to digital cockpit, autonomous driving and new energy. In September, the first Power Swap Station manufactured at the Nio Power Europe Plant in Hungary rolled off the production line.

Investments like these will prove pivotal in the race towards a cleaner, smarter transport ecosystem. If Nio wants to run with the big dogs, it’s par for the course. In addressing the key to global success, Qin emphasised the focus on product and service more than anything else, trusting that volumes and profits will follow: “When we see high satisfaction levels among our customers, we are more motivated to develop the business. We pursue user satisfaction on a continuous basis. That way, the sales number becomes the result as opposed to a pre-set target.”
Solar EVs could provide freedom from the grid

As charging infrastructure lags behind EV uptake, the affordability and energy efficiency of solar-powered vehicles has an advantage. By Will Girling
Adequate charging infrastructure will be necessary if the shift from internal combustion engines (ICEs) to battery electric vehicles (BEVs) is to be successful. However, with electrification progressing faster than previously anticipated, there could be challenges on the horizon.

EY estimates that Europe will experience a dramatic increase in BEV uptake over the next decade—from just under five million in 2021 to 130 million by 2035. To support these vehicles, the total number of charging points would need to grow from 374,000 to 65 million, including both public and private infrastructure. The consequence of this many vehicles charging simultaneously using contemporary electric grids, states EY, could be energy blackouts and overloads. A similar recognition of the need for upgrades and investment has also been noted by authorities in North America and Asia-Pacific (APAC).

The importance of grid management in all cases is clear. However, the ultimate success or failure of EVs will be their ability to meet different markets’ infrastructure challenges, as well as consumers’ affordability and practicality requirements. At a time when global charging infrastructure is still uneven, an emerging vehicle class is well positioned to alleviate grid strain and level the playing field: solar-powered EVs (SEVs).

Leaders from two of the world’s most prominent SEV manufacturers—Lex Hoefsloot, Chief Executive of Lightyear, and Chris Anthony, Co-Founder and Co-Chief Executive of Aptera—weigh in on the technology’s place in the future of mobility.

**Freedom from the grid**

“Solar-powered EVs are part of the solution to a very complex worldwide problem,” Hoefsloot tells *Automotive World*. “The more electric mobility continues to grow at a global scale, the higher the demand will be for more charging infrastructure, batteries, and rare earth materials.”

The environmental, economic, and logistical costs of accommodating this demand, he adds, are likely to be considerable. “For example, in the Netherlands, nearly two million EVs are expected to be on the road by 2030, which would require 1.7 million charging stations. However, at the moment, there are only 90,000 charging stations nationwide.”

Making up such a large deficit is unlikely to be cheap. Global
consultancy ICF found that, depending on the equipment, the total cost of installing new charging points can vary between US$2,700 and US$130,000 per unit. For countries with a head start on developing EV infrastructure, this may be affordable. However, countries such as Poland and the Czech Republic, which were joint last on LeasePlan’s EV Readiness Index 2022, have a far larger and more expensive task.

For Anthony, SEVs are valuable because they help mitigate this issue and provide freedom from the grid, particularly in areas with underdeveloped infrastructure. “SEVs make clean transportation more accessible and more affordable, especially in places where charging infrastructure is sparse or there is an unreliable power grid.” While the majority of consumers still list range anxiety as their primary concern about EV ownership—57% according to consultancy firm Kalibrate—an EV that doesn’t depend on the availability of charging stations would be enticing.
NEITHER APERTA NOR LIGHTYEAR CLAIMS THAT ITS VEHICLE CAN ENTIRELY DIVORCE CONSUMERS FROM USING THE GRID, PARTICULARLY FOR LONGER JOURNEYS. DESPITE THIS, BOTH OFFER LONGER FULL-CHARGE RANGE SPECS THAN THE 360 MILES PROVIDED BY THE TESLA MODEL 3–1,000 MILES FOR APERTA AND 450 MILES FOR THE LIGHTYEAR MODEL 0. AS SUCH, SEV OWNERS WILL STILL CHARGE LESS OFTEN THROUGHOUT THE YEAR THAN BEV USERS.

“SEVs are a viable solution to reduce dependency on infrastructure because they intrinsically use energy much more efficiently,” says Hoefsloot. The Lightyear 0, he states, consumes three to eight times less energy depending on the strength of the solar irradiation. “When you extrapolate those energy savings to a larger number, there is clear evidence that SEVs can relieve the strain on the grid.”

Indeed, as urban commuter vehicles for shorter journeys, the full potential of SEVs becomes apparent. In cloudy climates, Aptera states that its vehicle can travel 20 miles per day without the need for additional, grid-based charging. Similarly, based on a roughly 20-mile daily commute, the Lightyear 0 does not need to be recharged for two months. The capacity for both vehicles also increases in sunnier climates: rising to 30 miles a day for Aptera and seven months for Lightyear.

While these solar-powered mileage capacities may seem low, they are significant: the global average daily driving distance ranges from 15.5 to 31 miles per day. Statista estimates that US drivers cover an average of 26 miles per day, while energy efficiency project Odyssee-Mure calculates an average of 20 miles in the EU. Evidently, for the majority of consumers, SEVs offer a practical transport solution.

If part of SEVs’ purpose is to broaden the accessibility of vehicles with an electric powertrain, they will need to address another core customer concern: affordability. With the average price of a new EV in the US sitting at US$66,000, Aptera’s

“SEVs are a viable solution to reduce dependency on infrastructure because they intrinsically use energy much more efficiently.”
US$25,900 starting price tag and global marketing strategy—Anthony says that US homologation will be followed by expansion to Canada and the EU—are likely to achieve this goal.

By comparison, the Lightyear 0 is priced at US$281,000, will be limited to a production of 1,000 units and sold only in the EU/Schengen Area. However, according to Hoefslott, this model represents a “technology differentiator”; the company is aware that a more affordable and accessible vehicle is necessary to manifest the full benefits of SEVs. “In 2025, we will launch Lightyear 2, our mass market model, which will be available in the UK, US, and eventually Asia, as well as other markets beyond Europe and North America.” The Lightyear 2 will be priced at a more moderate US$30,000.
A broader role to play

In 2022, EY’s Mobility Consumer Index noted that sentiment in favour of buying an EV exceeded 50% for the first time. Clearly, the dominance of internal combustion engines is waning, but are consumers prepared to take the extra step from BEV to SEV? Anthony believes that the practicalities of SEV ownership make this transition logical: “Drivers want their vehicles to be more efficient and eco-friendly. Aptera and all other SEVs are a step forward in this direction.” On the other hand, Hoefsloot believes any change will be more incremental and based on the willingness of consumers and the industry to embrace new technology. “Our aim with Lightyear 0 was to show that clean mobility is a reality and is ready to go. The sooner this technology is adopted, the higher the production volumes, which will then allow for lower prices.”

With the European Commission and the US state of California approving commitments to selling only zero-emission vehicles from 2035 onwards, and the UK putting forward similar legalisation from 2030, it’s clear to Hoefsloot that “the future of cars is electric.” Moreover, with transport accounting for 37% of total global emissions, and a 2018 survey by Futerra indicating that 88% of consumers in the US and UK favoured brands that helped them reduce their carbon footprint, the promotion of SEVs as a clean and affordable option that doesn’t sacrifice performance could hold strong appeal.

According to the International Energy Agency, BEV and hybrid stock rose to 16.5 million in 2021—three times its 2018 level. This rapid increase in uptake is a step in the right direction, concludes Hoefsloot. Yet, the new challenges these vehicles present mean that mobility has not yet arrived at an optimal solution, particularly regarding the shortage of charging stations and an overloaded electricity grid. “SEVs can address both those issues through their efficient energy usage and reliance on one of the cleanest forms of energy we have: the sun.”
For over a century, automakers have focussed on handling and horsepower in the quest to attract customers. But as the engine is replaced with a battery and the car takes over the task of driving, the focus turns to the user experience (UX). The digital revolution, connectivity and automated driving could dramatically reshape that experience in the coming years.

Design agency NewTerritory has been working on creating unique and compelling experiences and designs for the transportation industry, primarily the aviation and rail sectors, but has more recently begun to apply its approach to passenger vehicles. Creative Director Tim Smith describes the London studio as a Willy Wonka chocolate factory, a place to explore and experiment with potential UX for the vehicles of today and tomorrow. As the automotive industry gets to grips with the implications of digital developments, the metaverse and multisensory immersive experiences, the race is on to create a brand-building and ultimately lucrative UX.

How are you and your team shaping the future of mobility?

We are original experience makers. Drawing on our team of industrial designers, digital designers, and creative technologies, we have the skills and the capability to design the interior experiences for vehicles. We have done this exact thing for planes and trains which are, in effect, a sort of autonomous vehicle. The driverless car is just a natural next step.

You’ve written a couple of books on automotive UX. Which trends were explored in those publications?

The first book, Are We There Yet? Designing the In-car Experience, was written ten years ago when we saw touchscreens moving into the car and noticed they were transplanting the iPhone experience. The trouble is that it’s the wrong context—you’re driving 70mph—so we wrote some guidelines around how to best design the UX for the car. The second book, Where are We NewTerritory describes itself as original experience makers and shares its vision for the ultimate automotive UX. By Megan Lampinen

The metaverse is just the start of in-car UX
Going? Humanising Autonomy, explored UX for driverless cars, including how blind people or autistic people might use the vehicle, and how cyclists and pedestrians might respond to it.

Partially automated driving raises some challenges for developers, particularly around keeping the driver engaged. What sort of work have you done on this front?

When I was writing that book about driverless cars, I was working with University College London (UCL), looking at partial autonomy when the car’s doing most of the work but there are times where you have to take over. This is less of a technical problem and more of a human cognition problem. If the car is driving for an hour at 70mph, and the human has been reading a book, how do you suddenly ask them to take control? UCL and I conducted some research about this problem and we came up with what we called the cognition Goldilocks zone.

As in, not too much, not too little, but just right?

Indeed, there’s the fairy-tale story, but I actually borrowed the Goldilocks Zone terminology from astronomy: if a planet is too close to its host star, it’s too hot for life; if it’s too far from its host star it’s too cold for life. There’s a sweet spot that is just right. With driving you can either be under-stimulated or over-stimulated. With our prototype test rig we can use biometric data and human physiology to understand if test subjects are under- or over-stimulated in a virtual driving situation. We can then use a multi-sensory experience—targeting smell, taste, touch, sight and sound—to bump them up or down, back into the Cognition Goldilocks Zone so that they’re a safer driver.

The multi-sensory test rig was simply a rough prototype, but what sort of principles can you take from it?

It allows us to control what vehicle occupants see, hear, smell, taste and touch. The metaverse experience is hot at the moment, and while quite immersive it is also very focussed on audio-visual. Imagine how much more immersive it would
Some automotive companies are worried about their lunch being stolen by tech companies like Google and Apple. This is a chance to win some of the lunch back.

What does a blind person get out of a metaverse right now? Not very much. But if we consider all of the human senses, it means that deaf people, blind people, and those that lost their sense of taste or smell will still enjoy it.

What does the specific in-vehicle environment offer for experience potential?

The car is a controlled environment. You probably don’t want to engage with the driver too much because they are driving, but you can give the passengers unique multisensory experiences. Within the car, we can know where everyone is sitting, their heart rate and temperature, and where they are going. With that you can give highly personalised, multisensory experiences. That’s been the inspiration of this rig.

What will be most interesting with the metaverse experience is utilising the unique qualities of the car. It’s the only consumer electronic you can step into and that transports you from A to B; it moves through space. If you’re going to have a metaverse experience in the car, let’s make sure that it’s unique to the car. Only the OEMs—like a Ford or Audi—can do this.

Could you give me a concrete example of an experience that would harness the unique offering of a vehicle moving through space?

Gaming is hot at the moment. When families embark on a three-hour journey, the parents often give their kids a tablet on which they can play a game. But that game can be played anywhere, and in the car that’s both a missed opportunity and a challenge. The challenge is that it creates motion sickness. The opportunity is to gamify the movement of the car to mitigate that motion sickness. Imagine I-Spy but instead of just looking down you incorporate the real world. Cars of the future will have exterior cameras, LiDAR, advanced GPS and so on; the car could get quite a granular picture of...
its surroundings. That’s an experience that Google, Nintendo, Microsoft or PlayStation cannot do, but Audi or Ford could.

Does it get more complicated than that?

How about a version of a movie for vehicles: Jurassic Park for the car? It’s either 90 or 150 minutes long depending on the length of the journey. If your car drives left, then you go down the left path of the film. If your car drives right, you go down the right. Everyone has a different experience because they might be driving from A to B, whereas you might be driving from X to Y. And it would be multisensory and interactive. The potential on these fronts is massive. There’re experiences in the vehicle that will be hugely lucrative and interesting.

What sort of modifications would be needed to the vehicle to provide this?

From a hardware perspective, it is already possible in the car. It’s just that software and user sensor design are needed to pull it all together. All of a sudden, you will see people who want to own a car because it has this technological capability that Google in the home just can’t compete with.

What could this mean for brand value?

Some automotive companies are worried about their lunch being stolen by tech companies like Google and Apple. This is a chance to win some of the lunch back, because only a car company can deliver that experience. You cannot get the same experience using Google Home. Your house isn’t set up like that, but a vehicle could be.

And this alone could be a brand differentiator?

The car companies now have an opportunity to not just sell 0 to 60 in four seconds but a whole new experience that you won’t get anywhere else. I worry about some brands when it comes to Level 5 autonomy. Volvo’s going to be fine but what is Lamborghini’s play in Level 5 autonomy? Imagine if Lewis Hamilton did the world’s fastest lap around the Nürburgring, you could get in your Lamborghini and do Lewis Hamilton’s lap.

Recently there’s been a bit of doom and gloom that Google, Apple and Tesla are coming along and we’re all screwed. But it just requires a shift in mindset, looking at a car less as a petrolhead type of product and more a modern piece of technology—a consumer electronic for a new consumer in a connected age. There’s still a huge amount of potential there.

You mentioned that experiences could prove lucrative. Which players will be making money from this?

In the long run, I don’t think it will be the OEMs. I see them increasingly becoming rolling stock providers with some brand exceptions. As soon as Ford creates the metal shell, the interior experience within is going to be a new, different brand.

Might that brand be NewTerritory?

Yes. It could easily be us. We are just taking our first step into it. This is just the sketch on the notepad.
The Russian invasion of Ukraine in February 2022 has dramatically impacted the former’s automotive industry. At that time, Russia boasted 34 automotive production plants, turning out cars, trucks, vans, buses and engines. Most of those have since been forced to suspend or scale back output in the wake of supply shortages and sanctions. Many Western and Japanese brands—including Volkswagen Group, Mercedes-Benz, BMW, Honda, Toyota, Nissan, Ford and Volvo—have halted their vehicle exports to Russia. But another group of players may find themselves with a new opportunity.

Asian brands could take advantage of the market vacuum as major global players depart. By Megan Lampinen
Leading Western and Japanese automotive brands have announced their withdrawal from the Russian market, but Korean and Chinese brands have elected to remain,” observes Stephen Dyer, Managing Director, Co-Leader, Greater China for AlixPartners. Their governments have made any moves to cut off business following Vladimir Putin’s action. Due to existing inventory already at local dealerships, sales of Western and Japanese vehicles have not stopped entirely but they have slowed to a trickle compared with the same period last year.

This could represent an opportunity for Chinese brands to step in and fill the gap. Several Chinese products have witnessed growing demand from Russia; this is particularly notable among value-added consumer goods like phones, printers and even vehicles. Russia is Great Wall Motor’s largest market outside of China and its revenue from that region jumped 14.2% year-on-year in the first half of 2022. Great Wall is currently expanding its production plant in Tula, located about 200km outside of Moscow, with the aim of boosting annual capacity to 80,000 vehicles.

“The share of domestic and Chinese automakers in the Russian automotive market will increase in the coming years,” predicts Nishita Aggarwal, Automotive Analyst at the Economist Intelligence Unit (EIU).”

Chery is also working hard to make that happen. The Chinese car manufacturer has reportedly been in talks for months to build its cars at Russian plants. Reuters reports that it recently sealed a deal with Avtotor, with the first Russian-built Chery models expected late in 2022. “The footprint of Chinese automakers in the Russian market is relatively small but it is likely to expand,” suggests the EIU’s Mario Bikarski, Europe Analyst.

New segments

Chinese brands have been selling vehicles in the Russian market for some time—Geely’s history there traces back to 2007. Along with Chery and Great Wall, it has been leading the Chinese offensive, but success has been limited. “Until now, the Chinese automakers in Russia have focused on selling SUVs, with sedan segments occupied by other countries’ brands,” notes Dyer. They have performed respectably, capturing almost a quarter of the SUV market this year. “Like Chinese consumers, Russian car buyers seem to appreciate the attractive exterior and interior styling, infotainment features, and value-for-money that Chinese brands excel at,” he adds.
Notably, Chinese models generally sell at a lower price point than Western or Japanese brands. Dyer suggests that these models’ lack of availability could lead to expanded market share of the lower-price segments in which Chinese brands compete. “With the vacuum in the sedan segments created by the withdrawal of many Western and Japanese brands, it might be an opportune time for Chinese players to bring in some of their more competitive sedans,” he tells Automotive World.

Russian automotive analytics agency Autostat reports that sales of Chinese-branded sedans in Russia grew by around 30% between April and May 2022. Dyer flags increasing opportunities for Chinese players to sell to fleets, including taxis and rental cars.

Russia’s belated move towards electric vehicles (EVs) could further boost opportunities for the more than 100 Chinese EV brands. The country removed its import tax on EVs in April 2020 and is expected to outline subsidies on the purchase of new electric models. Local reports estimate the government could cover 25% of the purchase price up to Roubles 625,000 (US$10,000). “We may see an increased presence of Chinese EV manufacturers in the next few years,” predicts Aggarwal.
Risk vs opportunity

Russia’s automotive market is a large one: it ranked eighth in terms of global sales in 2021. Chinese brands may understandably be tempted to fight for a foothold in such a region. Its allure is not limited to automakers—suppliers may also find rich pickings to be had. “There is definitely an opportunity for Chinese suppliers, both in the aftermarket parts business and the original equipment supply business,” adds Dyer. “With over 60 million vehicles on the road in Russia, the withdrawal of Western suppliers and halting of parts imported into Russia have left a large supply gap, which could be at least partially filled by Chinese auto parts.”

But while the market is large, it is also volatile. “In a market such as Russia, the ongoing possibility of variable or declining economic performance makes investments risky,” Dyer confirms. “There are also risks of policy changes related to import tariffs, which directly influence decisions on how to compete in the market, such as through complete vehicle imports, locally assembled kits, or for aftermarket parts.” Despite this, he also notes that there is limited potential exposure to Western sanctions, due to the low sales of the leading Chinese automakers in Western countries.

Russia clearly has its challenges, but like any volatile situation, there will be players that can turn it to their advantage. Just how sizeable and lucrative that advantage is for Chinese manufacturers depends on numerous factors. Dyer cautions that the brands remaining active there “may not be able to completely satisfy the demand for higher price-segment vehicles. This will likely lead to a supply-constrained market in coming years.”
The Inflation Reduction Act continues the recent trend of the federal government stressing its commitment to the domestic manufacturing of electric vehicles (EVs) and batteries. The bill provides US$30bn in production tax credits to bolster manufacturing of clean energy technologies in the US, including batteries and critical mineral processing. It also dedicates a US$10bn investment tax credit to build clean technology manufacturing facilities, such as EV factories, among other funding allocations. This complements the US Department of Energy’s announcement earlier this year that dedicated US$3.1bn from the Infrastructure Investment and Jobs Act to be used to support the build-out of a domestic critical mineral supply chain that will support battery and EV production.

These announcements are just the latest in a series of efforts by the Biden administration to encourage the development of domestic supply chains for critical materials used to make lithium-ion batteries, the dominant battery technology used to power today’s EVs. Domestically

Policymakers should turn their eyes to funding the buildout of robust domestic supply chains for a diversity of battery materials. By Mukesh Chatter
sourcing batteries and EVs brings major benefits, such as curtailed geopolitical risks, domestic job creation, and accelerated EV adoption.

Despite all of this, prices for these battery materials have surged in recent months, and analysts expect them to rise further over the next few years. With the battery pack accounting for approximately 40% of the entire cost of an EV, automakers like Tesla, Rivian, and Cadillac have been pushed to raise the prices of their Evs, making EVs even more unaffordable than they already were.

“Considering the current reliance on lithium-based batteries using materials sourced from abroad, is it even possible for domestically manufactured EVs to reach cost parity with conventional vehicles?”
for a majority of Americans. This inhibits the widespread adoption of EVs, the opposite of what’s necessary to make a meaningful impact on emissions.

Beyond funding for domestic manufacturing, the Inflation Reduction Act also includes tax credits for consumers who buy used and new EVs. However, EV buyers are only eligible to earn these credits on the purchase of American-made cars, and only if the majority of battery components come from North America, and contain a certain percentage of minerals from countries with free trade agreements with the US (which does not include China and Russia, nor any of the African countries where more than 70% of all cobalt is sourced). As it stands now, most finished EV batteries are produced in China, or rely on lithium and cobalt that’s processed there. Metals mined and processed in North America will undoubtedly be more costly, potentially making batteries even more expensive—not less.

This raises the question: considering the current reliance on lithium-based batteries using materials sourced from abroad, is it even possible for domestically manufactured EVs to reach cost parity with conventional vehicles? According to the US Department of Energy’s Vehicle Technologies Office, battery costs need to fall by more than 50% to US$60 per kWh for an EV’s total cost of ownership to reach US$0.26 a mile, compared to US$0.27 for a conventional vehicle with an internal combustion engine.

In order to make domestic, affordable EV and battery manufacturing a reality, automakers need to explore the use of lower-cost, readily available materials with more predictable supply chains. This will allow manufacturers to avoid price
fluctuations due to geopolitical scenarios as well as reduce shipping costs to transport these materials to processing and manufacturing facilities. These materials also need to cost less than lithium while offering the same quality of performance. Ideally, they would also be safer and better for the environment.

These alternatives exist. Policymakers and automakers should keep a keen eye to the diverse materials being used to build clean technologies—specifically batteries—and focus funding towards building domestic supply and manufacturing for these game-changing battery materials. These lithium battery alternatives can be the key to building a cost competitive domestic supply chain for EVs and EV batteries. Because in the end, we want to make our EVs and batteries in America, and we want every American to be able to afford one.

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

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Nikola Motors: “We are in control of our battery destiny”

Nikola's CEO offers a deep dive into the proposed acquisition of Romeo Power. By Megan Lampinen
 Batteries represent a huge portion of the overall cost of electric vehicles (EVs) and are pivotal to performance, safety and customer acceptance. The more stable and secure an automaker’s battery supply, the better. That’s why some players are moving to bring battery expertise in-house. BYD, Tesla and Great Wall have led the way on this front by fully integrating battery production. Others have started along that journey: Volkswagen, Daimler and General Motors are just some of the incumbents to have made hefty investments in the area. Now it’s Nikola Motors’ turn.

On 1 August, Nikola announced a definitive agreement to acquire one of its current lithium-ion battery suppliers, Romeo Power. The battery specialist was founded in 2016 by a group of former engineers from big name players like Tesla, SpaceX, Apple, Samsung and Amazon. It went public last year through a merger with investment firm RMG Acquisition.

“Batteries are constantly changing and improving,” Nikola Chief Executive Mark Russell told media and analysts in a call following the acquisition announcement. “We have a world-class battery being produced now, based on Romeo’s module, thermal system and battery management system software. With this acquisition we get the people responsible for that on our team.” Romeo will bring an additional 400 battery experts into Nikola’s fold following the deal completion, expected in October 2022. Russell believes this talent will put Nikola in a good position as market competition heats up. The automaker kicked off mass production of the Tre battery-electric truck at its plant in Arizona in March 2022.

**Keeping its options open**

Nikola is Romeo’s largest customer but the truckmaker also has a battery sourcing agreement with Proterra, which it plans to maintain. This dual sourcing strategy is designed to give it the best of both worlds: security with an in-house supply but a back-up to keep its options open. “It is important that we stay dual source and have supply options for such a strategic component, but this will give us our own battery team and our own battery facility to focus on things going forward,” said Russell. Romeo recently opened a brand new battery facility in Cypress, California, which will become Nikola’s battery centre of excellence.
The strategy went down well with the investment community. “Dual source makes total sense on a risk basis,” observes Bill Peterson, a Wall Street Analyst at JP Morgan. As for the ideal sourcing balance between Proterra and Romeo, Russell would only say that this would be determined by whatever is most efficient. “You would prefer an in-house capacity because there’s no margin between you, but we are focussed on having an alternative and will continue to work with Proterra,” he said. He pointed out that Proterra has its own unique capabilities as well as advantages in terms of geographic coverage, particularly as it plans to serve Europe, that Romeo doesn’t have. “Proterra will be an important partner going forward. We plan to keep our options open,” he emphasised.

The long game

Huge benefits are expected from the move to take Romeo in-house. Annual cost savings are projected at US$350m by 2026, and as early as 2023 Nikola believes it can slash non-cell related battery pack costs by 30-40%. “That’s a pretty big number,” points out Michael Shlisky, Senior Analyst at DA Davidson, The bulk of these savings will be realised from adjustments in the pack.
enclosure, one of the biggest cost elements. Pack enclosures are currently machined but will be transitioned to casting, which could slash costs by 70-80%. Additional cost savings are expected to come from greater factory automation, improved processes, localisation of thermal parts and supply chain cost savings.

For now, though, Nikola, may feel a financial pinch. Its offer is for US$0.74 per share, a 34% premium to Romeo’s closing price at the time of the announcement. That values the purchase at US$144m. Nikola will also provide Romeo with US$35m of funding to ensure continued operations until the deal closes. “That puts a little pressure on cash flow near-term but is a big opportunity long term,” noted Jeff Kauffman, Principal, Transportation & Logistics Equity Research at Vertical Research Partners.

Essentially, Nikola believes that control over the essential battery pack technologies and manufacturing process will help it accelerate the development of its electrification platform and better serve its customers. This is becoming all the more important as the electrification landscape becomes more sophisticated. “For the long term it is important that we are in control of our battery destiny and have our own capability for manufacturing and engineering in-house,” said Russell.

What it does not intend to do, he emphasised, is get into the merchant battery business. Once its contractual obligations to other customers are met, Romeo will supply Nikola exclusively. Current terms require it to give customers six months’ notice of contract termination.

So far the transaction has been approved by both companies’ Boards of Directors but remains subject to the tender by Romeo’s stockholders of shares representing a majority of the outstanding Romeo common stock, and customary closing conditions, including regulatory approval. Provided all these steps come to pass, a newly-formed subsidiary of Nikola will be merged into Romeo.
LiDAR sensors can help build AV market growth and trust

Innoviz’s Chief Executive explains why the growth of the LiDAR market will be crucial as autonomous features become more commonplace.

By Will Girling

By 2030, the total number of autonomous vehicles (AV) globally is expected to reach 62.4 million, up from 20.3 million in 2021. As such, it is not surprising that LiDAR—the sensor capable of rendering digital 3D representations of its immediate surrounding—is forecast to enjoy similar growth. Indeed, Grand View Research estimates the market value will rise 160% across the same period from US$1.8bn to US$4.7bn.

LiDAR technology is proving itself to be essential in the quest to realise truly self-driving vehicle services. From autonomous buses in the UK to robotaxis in China and last-mile transport in the Arctic Circle, it underpins...
the real-world modelling upon which many manufacturers are basing their hopes for unlocking AVs’ potential.

**Innoviz: Tier 2 to Tier 1**

One player that has witnessed the market’s transformation in recent years is Israeli LiDAR expert Innoviz. Having founded the company in 2016, Chief Executive Omer Keilaf informs *Automotive World* that the formerly limited industry is beginning to open up. “There used to be a single Tier 1 that offered LiDARs to automotive. That’s not the case anymore.” Among Innoviz’s first high-profile clients was BMW in 2018, to which it supplied solid-state LiDARs in collaboration with Canadian vehicle systems supplier Magna.

Innoviz had primarily been acting as a Tier 2, but the development of a new product in 2021, InnovizTwo, introduced a new business model. “We decided to engage with automakers directly,” states Keilaf. “The benefits of doing so are obvious: as the price points for LiDARs increase, OEMs are looking for value that doesn’t compromise performance. Vertical integration is a good way to reduce the pressure.”

InnovizTwo was designed to be a low-cost (around 70% cheaper on average) LiDAR solution that facilitates safer and easier SAE L2+ autonomous functionality for a greater number of car manufacturers.

“Overconfidence is what leads to road accidents. If it is brought into vehicle development earlier, LiDAR can help solve that problem.”

It achieves this through hardware that accommodates upgradable software, which will enable L3 and L4 capabilities as these develop without the need for replacing the original product.
The company’s ongoing goal, highlights Keilaf, is not just to provide LiDARs themselves but also the accompanying perception software. This ambition was noticeably realised in August 2022 when the company signed an eight-year, Tier 1, US$4bn deal with Volkswagen. The contract was awarded in recognition of Innoviz’s reputation for thorough testing, due diligence, and a focus on safety.

**Leading innovation**

“German automakers like VW and BMW are leading innovation in the LiDAR space because they’re working closely with tech companies,” Keilaf states. So, does this OEM interest indicate that advanced driver assistance systems (ADAS) are reaching maturity and full AV functionality is on course for realisation?

Market data analyst Statista projects that the ADAS market alone will be worth US$58.6bn by 2028, more than double its 2020 value of US$27.3bn. However, Keilaf believes that, although activity appears to be picking up now, this momentum has been building behind the scenes for far longer. “Our contract with VW was an ongoing process that took two years to secure. At the same time, other automakers began sourcing their own LiDARs—a lot of effort is being invested in securing the right technology for inclusion in passenger vehicles for 2024 and beyond.” As such, he summarises, any silence on the issue or avoidance of bullish claims merely highlights the desire to perfect ADAS/AV features before publicising them.

Furthermore, by early 2023, Keilaf predicts a greater number of car manufacturers will announce L3 capabilities. Because its OEMs have been early adopters and are organisationally equipped to take risks, Germany will remain a leading LiDAR investment market. “This is why we targeted VW and BMW—we knew they would be able to make a
fast decision,” he clarifies. However, the US and Asia will likely be the focus of the next wave of investment. Japan Post, for example, announced in July 2022 that it plans to use InnovizOne LiDARs as part of its plan for automated postal delivery vehicles. Astute Analytica estimates that the nation’s smart city market could grow from US$45bn in 2021 to US$93bn by 2027.

AVs and negative press

Perhaps one of the AV market’s most significant obstacles is a lack of public trust and consumer familiarity. A paper published by the UK government’s Centre for Data Ethics and Innovation determined that, even if AV-related incidents or collisions are infrequent, the public is likely to have an amplified negative response. “Average improvements in road safety, even if they can be clearly demonstrated, will not engender public trust if crashes are seen as the fault of faceless technology companies or lax regulation rather than fallible human drivers,” it said.

Despite this, Keilaf does not believe these present concerns will impact future LiDAR market growth. “Some reported incidents were with cars that only had L2 capabilities—in other words, they didn’t have LiDAR sensors,” he says. “Rather than being a barrier, those rare examples should actually encourage further investment in LiDAR as a safety technology.” Part of the problem, he adds, is the confusion surrounding the SAE’s levels of autonomy. A vehicle with L2 features still requires the driver to be in full control and therefore does not represent autonomous driving at all.

Keilaf advises that automakers would be wise to incorporate LiDAR as a form of indemnity as autonomous features continue to gain complexity. “Overconfidence is what leads to road accidents. If it is brought into vehicle development earlier, LiDAR can help solve that problem by providing drivers with a more accurate sense of the road and their car’s capabilities.” Indeed, the safety benefits of LiDAR could be essential not only to market growth but also the end of negative press for AVs.
NAIAS legitimises air mobility’s place in automotive

The North American International Auto Show introduced the Air Mobility Experience this year. Megan Lampinen takes a closer look
Auto shows continue to evolve as cars give way to mobility ecosystems. As a case in point, this year’s North American International Auto Show (NAIAS) introduced the Air Mobility Experience, a glimpse into the future of transport within the third dimension. With flight demonstrations and displays, the showcase shone a spotlight on the nascent market for electrical vertical take-off and landing (eVTOL), hoverbikes, hoverboards and jet suits. It’s a radical departure from the traditional motor show bread and butter, but at the same time reflects the evolution of the transport industry.

Rani Plaut, Chief Executive and Co-founder of eVTOL developer AIR, believes that air mobility is a pivotal piece within the “deck of solutions” that are emerging to help individuals move from A to B. “It’s a smart move on the part of the Detroit Auto Show to feature the next generation of transportation,” he tells Automotive World. “For visitors, it is not only about buying cars, but also playing a part in this transportation story through which we are all living.”

Tel Aviv-based AIR displayed its AIR ONE two-seater eVTOL aircraft, while Detroit’s own Airspace Experience Technologies showed its Sigma-6 eVTOL model targeted at urban commuters. There was also the Xturismo Hoverbike, designed as a luxury air cruiser, from Aerwins Technologies and ALI Technologies, with an eVTOL Hoverboard from Omni Hoverboards. The UK’s Gravity Industries also showed off its 1,000hp Jet Suit.

All of these could fill a different gap in the current mobility picture. The Jet Suit, for instance, is targeted at search and rescue, paramedic, entertainment and defence applications. AIR ONE is designed for private consumers, while the Sigma-6 is targeted at the air taxi and cargo market.

Plaut likens developments and offerings for the third dimension to what’s played out within ground transportation. “As this domain translates into the air, you will have your UPS and FedEx cargo equivalents. Then there’s AIR, which represents passenger cars. You have your hobby offering in the form of the hoverbikes,” he says. “It is a smart showcase of the segment’s ability to grow.”

Potential impact and obstacles

Plenty of players are exploring various takes on air mobility, and the overall impact of these solutions could be significant, particularly in terms of congestion and air pollution. “The planet is stuck,” asserts Plaut.
“The planet is suffocating. There is a lot more air space than road, so air mobility could be a good solution.”

The key obstacles at this stage, he suggests, are issues around the operator’s skillset and infrastructure, but there are solutions. Today, just about anyone can become a car driver, but it’s not the same process to become a pilot. If this remains the case for air mobility, it will never reach the masses. Plaut believes the answer is to go fly-by-wire, which would drastically reduce the skillset required. “Here, the vehicle is handled and operated by a sophisticated computerised system that keeps it stable. The ‘pilot’ could be reduced to the level of a driver.”

As for infrastructure, eVTOLs require significantly less space than a helicopter as they do not have the same sort of rotor thrust. They also produce much less noise than a conventional aircraft, where 50% comes from the motor and 50% from the blades. The shift to electric propulsion of multiple small rotors slashes that output. “eVTOLs have the potential to contribute to solutions that reduce congestion and pollution,” he emphasises.

**Crawl, walk, run**

Rushing into developments too quickly, though, could result in a consumer backlash. “It is important for an emerging domain not to aim too high,” Plaut cautions. “The term ‘urban air mobility’ creates anxiety that is wrongly applied.” He points to the previously common sight in

The AIR ONE can be seen on display at Aeroauto, the world’s first Aeromall showroom located in Stuart, Florida.
Manhattan of helicopters on roofs in the 1960s. That disappeared after a tragic Pan Am helicopter crash in 1977. Since then, he suggests, people have become wary of seeing a carsized object flying 300 feet over their heads.

In his view, air mobility makes a better fit for rural areas or the outskirts of cities. “Crawl, walk, run is the right approach,” he emphasises. “We don’t have to jump straight into this at the deep end.” In this sense, hoverbikes could play a key role in introducing the concept of flying mobility to consumers. He describes it as “a first step in the evolution of public perception” and one that could go far in addressing psychological obstacles.

Similarly, featuring air mobility at an event like NAIAS could be pivotal for wider consumer acceptance. “If I told my grandfather that we were going to drive at 60mph in cars that weighttwo and a half tons, and that tens of thousands of cars would operate together on the road, he would have lost his mind,” says Plaut. “Today you think nothing of it. Showing air mobility at such an event puts it next to people, and lets them feel comfortable with it.”

He has seen considerable progress in terms of consumer comfort over the past few years, noting a transition from “oh my God, this can’t be real” to trivial questions about where to buy one and what they cost. As with ground vehicles, that spectrum is huge. Air mobility vehicles designed for commercial use like taxis can cost in the millions, with the ROI paid off by the trip fares. AIR is targeting private mobility with a price tag of US$150,000 to US$200,000 per unit. The company is currently accepting pre-orders, and has received about 200 so far, but certification and deliveries are not expected until 2024.
A 2020 survey of 2,000 electric vehicle (EV) drivers in the UK by Zap-Map found that less than 1% would consider returning to gasoline-powered cars. Notably, all-electric vehicles scored higher ownership satisfaction scores than hybrid models as well. This indicates that, once they have tried an EV, consumers are generally convinced of their superiority.

However, the International Energy Agency estimated in 2021 that only 10% of global car sales were EVs. So, what is preventing customers from making their first EV purchase? Not surprisingly, issues concerning charging times, range and price continue to be among the most prominent factors. Clearly, EVs are going to need to prove both their practicality as well as their eco-friendly credentials.

**A car for everyone?**

It was this brief, says Citroën’s Head of Advanced Products and Mobility Solutions Anne Laliron, that the automaker is striving to accomplish with its ‘oli’ SUV concept. Having begun the project in 2020, she tells *Automotive World* that the goal was to...
“create a car with a significantly reduced carbon footprint while also being an accessible mobility option for all.” 2030 has been set as a potential release date for the vehicle.

With an estimated price tag of around €25,000 (US$24,296), the oli would be almost 50% cheaper than the average cost of a new EV in the EU. “There’s not much difficulty in building a US$100,000 luxury car, but delivering a versatile EV that’s accessible to a broad audience is a challenge,” states Laliron. In addition to being cheaper, oli’s range spec is set at 400km—slightly higher than the industry average of 313km. This is delivered by a 40kWh battery, which generally produce much lower ranges of around 240km. Citroën partially achieved this range boost by having a very low vehicle weight of less than 1,000kg.
Beyond its affordability and practicality, Laliron is convinced that a focus on sustainability will enable the oli to transcend demographic pigeonholing. “Our research has found that every customer cluster is concerned about their environmental impact; their ecological footprint is becoming increasingly linked to identity.” Therefore, she views oli as an obvious cross-market solution.

**Reduce, reuse, recycle**

Other manufacturers, such as Fisker, have argued that electrification is only the start of building a cleaner automotive industry. In order to make a real environmental difference, OEMs will need to scrutinise their supply chains at a granular level. “Citroën always uses a life cycle assessment (LCA) approach to assess the extraction of materials, manufacturing, the consumption of the product, and end of life recycling,” confirms Laliron. As such, the roadmap for developing the oli factored in sustainability from the very start.

“Materials are just one part of the story,” she continues. “Efficiency is really the key, because that relates to the vehicle’s overall consumption.” Indeed, Citroën’s target was to achieve 10kWh per 100km, which meant scaling back on infotainment features that might consume excess power. However, it also made weight and material reduction a primary concern. Installing a lightweight battery—one of an EV’s heaviest components—was a good starting point, but it also meant examining the oli’s design for “unnecessary” or “aesthetics-only” components.

Subsequently, Citroën reduced the seats from 37 parts to eight, used a specially treated reinforced lightweight cardboard honeycomb structure that is stronger than steel for its roof and bonnet, replaced carpeting with a foam floor, left bodywork components unpainted, and much more. This utilitarian approach doesn’t compromise function or safety—the roof, for example, weighs only six kilograms but can comfortably support the standing weight of an adult. “Our partnership with BASF guided our material decision-making,” says Laliron. “We incorporated as many recycled materials as possible because we want the oli to be eco-friendly in every way, even for the 95% of the time people aren’t driving.”
Citroën insists that whatever customers might lose in extra features, they’ll gain in ease of ownership. The oli’s exterior body parts—doors, windows, bumpers, and wheel arch contours—can interchangeably be fitted to either side of the vehicle. Furthermore, all are constructed from recycled or recyclable parts. These elements combine to create a car that is easy and cheap to maintain, while also extending its operational lifespan.

“Efficiency is really the key, because that relates to the vehicle’s overall consumption.”
A lab on wheels

In many ways, the oli is the big brother of Citroën’s 2020 Ami model—an EV so small that UK drivers could drive it with a moped licence. Laliron calls the SUV concept a “lab on wheels” and one that indicates the automaker’s future direction: “Our intention is to provide environmentally responsible and affordable solutions for all. The oli has enabled us to develop new innovations that we can now inject into the vehicles to come.” Now, all that remains is for customers to join the mobility revolution that EVs represent.

Citroën’s own research, she states, corroborates Zap-Maps survey: drivers who adopt EVs rarely return to internal combustion engines. Moreover, EV ownership has a direct effect on customers’ driving habits—they are more inclined to plan their trips in greater detail to account for charging points. This goes hand-in-hand with desirable vehicle criteria revolving less around traditional metrics like speed and more towards practicality. “We have limited the oli’s top speed to 68mph because we don’t think people will mind; there’s no real need to go faster, meanwhile this allows us reduce consumption even further,” says Laliron.

Overall, the oli represents an experiment to determine what consumers truly desire from cars and how much they might be willing to sacrifice for affordability and sustainability. If Citroën’s approach is correct, cars could start to become less about what customers ‘want’ and more what they ‘need’. With Statista’s survey of 8,400 US adults finding that fuel efficiency (56%), safety (55%) and low price (46%) are still the top three most important purchase factors, the attractiveness of Citroën’s strategy could find favour outside of its native European market, too.

“The challenge will be to get people to experiment with EVs for the first time, but we’re confident that a focus on sustainability and accessibility will convince them,” says Laliron. Indeed, if it proves popular, she concludes that the oli’s DNA could impact Citroën’s vehicles for generations.
How to turn EVs from grid threat to balancing opportunity

A smart EV charging management platform could change the industry’s energy footprint. Megan Lampinen hears more

The ecosystem required to support electric vehicle (EV) charging is incredibly complex, involving numerous players, working in diverse environments, that all need to communicate in an organised way. A lack of coordination or poor communication at any stage could interrupt pivotal power supplies or taint the end-user experience. Broken or unavailable chargers, unexpected high energy demand, inaccurate billing, or a lack of green energy make for unhappy fleets and consumers, potentially thwarting the success of the e-mobility revolution and its sustainability targets.

This is where Driiz comes in. “Our operating system serves as the glue between the mobility world and the energy world,” says Doron Frenkel, Driiz Founder and Chief Executive. The Israel-based company offers a smart software platform for EV charging and energy management. It boasts more than one million drivers on the platform, which is supporting around 600 different types of chargers. Its mission is all about charging in a smarter, more efficient way.

“Let’s recharge the planet,” Frenkel tells Automotive World. “Let’s decide how we consume energy. Let’s generate what we need and reduce pollution. This is about how we can enable the grid to work in the most effective way.” A big part of that entails looking at EVs not as a threat to the grid but as an opportunity to balance it. “If we succeed in doing that— and it’s what we aspire to—we can use this EV revolution to change the energy footprint.”
Multi-player game

Driivz works with many players to make this happen. The power network alone is a maze of relationships, starting with the energy producers. These companies can use a range of power generation sources including coal, gas, and green energy such as windmills and solar photovoltaic (PV) cells. This energy then needs to be transferred from where it’s generated across a region or a country. High-voltage towers are spread between cities and feed into a low-voltage network, known as the grid. The distribution system operators (DSO) serve as the grid managers and provide the power lines from the high-voltage towers to homes or commercial sites.

Then there are the utilities, which generally work with consumers. On top of these are parties helping to balance the demand on the grid by storing excess energy produced off-peak.

When it comes to plugging in an EV, even more players are involved. Charging can take place at home, at work or at a public station. For multi-dwelling units (MDUs) like condominiums, the management company may play a role. At the workplace or at a shopping mall for example, it's the commercial or industrial building management team. For fleets, both the fleet manager, who has responsibility for the vehicles, and the facility manager, who has responsibility for the power and parking, need to contribute to the solution. All in all, there are a cacophony of voices at the table.
Energy management

Workplace charging could prove a particularly hot spot for software management, due to the potential complexity. Frenkel, like many others, believes that EV drivers will increasingly charge where they live, work and play; they are less likely to park somewhere to charge. That means charging frequently at work, at home, at their destination or in-route. “Workplace parking spots are the future gas stations,” he asserts.

If not managed properly, that could become a logistical nightmare. The workplace is a semi-public environment. There could be multiple tenants at a facility or just one company, with numerous chargers networked together. But most buildings today are not ready for mass EV charging; if all the employees or fleet vehicles charged simultaneously, there simply would not be enough power. How is the energy allocation managed? How is it billed to the correct user? How is priority given to certain vehicles over others?

Driivz' platform can help with all these areas. It allows an organiser to register and reserve chargers, so that employees will know which units they can use when they arrive every day. It can also prioritise charging and give power to specific vehicles. For instance, a salesperson who needs to be on the road will be given priority over someone that stays in the office all day.

“Today it’s mostly about balancing the amount of charge, avoiding simultaneous charging and the risk of the breakers breaking and causing issues with the DSOs or the utility companies,” says Frenkel. Moving forward, battery storage will play an
increasingly important role in the mix. Frenkel sees tremendous potential in using EV batteries as energy storage resources, helping to meet demand and balance the grid. This is particularly important in the move towards renewable energy, which is produced intermittently and needs to be stored during periods of peak production. “It’s about adding renewables, local power generation and harnessing batteries to assist the grid if there’s not enough power,” he adds.

While vehicle-to-home is available today, but down the line, vehicle-to-grid (V2G) technology could become the norm. This allows EVs to not only accept power from the grid but also give it back when they don’t need it, or when it’s most expensive and in highest demand. Not all vehicles support V2G capability, though the numbers will grow. Using Ford’s Intelligent Backup Power system, for instance, the F-150 Lightning model can be used to power home appliances in an emergency.

“The grid itself is ready for V2G, because of solar PVs and smart metering, but a full commercialisation will take a lot of time,” Frenkel predicts. “Beforehand, a viable business model and the ability to balance the grid by deciding when you charge / dis-charge is the critical thing.”

Those decisions are made by the software platform. “Most users just want something to work. They don’t care how it works,” he says. “We are not asking EV drivers to do anything around that. The AI algorithms predict when to charge and when not to charge and/or feed power back to the grid.” The platform also enables drivers to press a button to simply charge as and when they want. This can cost up to five times as much, but there are instances where the extra cost is worth the convenience.

We can use this EV revolution to change the energy footprint

Outlook

Frenkel started Driizv a decade ago, when there was still a big question mark over EVs. “When I talked about the need for energy management ten years ago, people looked at me and thought, ‘I don’t know about this crazy guy’.” It’s taken time, but the message has been received. More than 60% of the public EV chargers in the Nordic countries are connected to the Driiizv platform.

In just a few years, Frenkel expects EVs to reach cost parity with their diesel and gasoline counterparts, and when that happens the numbers on the road will skyrocket. By that point, grids and EV charging must be smartly managed and balanced or the whole market could fall apart. “It’s a complicated environment,” he emphasises. “Software needs to connect all the pieces together. Otherwise it will be a mess.”
Predictive maintenance pivotal to electric fleet success

Switching to electric buses shouldn’t hurt a fleet’s bottom line, argues Miguel Simão
Climate credentials are no longer a ‘nice to have’ but rather an essential element for many companies. Combine this with ambitious targets of reducing greenhouse emissions by 55% by 2030 with the European Green Deal and the EU’s proposition to ban sales of all internal combustion engine (ICE) vehicles from 2035 and it’s clear that shifting to electric vehicles (EVs) has never been higher in the priorities of fleet operators.

Moving towards electrification is no longer something that only large public transport fleets do; providers of all sizes will have to make the shift within the next few years to ensure business continuity. With electric bus sales across the EU forecasted to grow by 83% in the next two decades, fleet operators need to take action now to get a better strategic understanding of the EV transition and the long-term impact on their bottom line.

However, EVs are a relatively new technology, and the upfront cost of an electric bus is still significantly higher than that of an ICE model. Furthermore, fleet managers are faced with the challenge of computing the life cycle costs of purchasing an electric bus and laying out the case for making the initial investment. As a result, the challenge for fleet operators is twofold. How can fleet managers and the transport industry gain a strategic understanding of the EV transition to help them to switch?

Predictive maintenance for economic viability

There is no doubt that transitioning to a fully electric fleet requires twice the investment when compared to standard ICE vehicles. However, electricity costs a fraction of fossil fuels, significantly reducing the operational costs. In order to capitalise on the lower energy costs and ensure a positive ROI, transportation services will need to operate vehicles for longer periods and more intensively when compared to traditional fleets. Utilising predictive maintenance in this process is a critical element to keep vehicles out of the workshop and on the road, enabling the economic viability that is needed for zero-emission vehicles’ mainstream adoption.

An electric bus has fewer moving parts, and these parts typically have longer life cycles, which significantly reduces the need for recurring maintenance. However, labour and components are generally more expensive in EVs, which means there are significant gains to be had in increasing their life as much as possible. Batteries are by far the most expensive component of electric buses, accounting for an average of 40% of the cost of the vehicle. For this reason, public transport fleet operators looking to make a profitable shift to electric fleets must consider how they plan to extend the life cycle of their vehicles’ batteries.
Much like smartphones, battery life decreases over the years and the range of electric buses becomes shorter over time. Manufacturers have tools at their disposal to extend battery life, such as thermal management and voltage limiting, but even then an EV that has a maximum range of 300km when new and only needs one charge to complete its daily route may require an additional charging session to complete the same distance after a few years. Additionally, the maximum distance the vehicle can travel on one charge may vary due to uncontrollable factors such as weather, traffic, route and vehicle load. The fleet manager must understand the limitations of their vehicles and the impact of these factors in order to avoid decreasing the service level.

Traditionally, vehicle maintenance is performed preventively, at estimated intervals. Sometimes components are replaced before their end-of-life, and other times breakdowns occur unexpectedly, causing service disruptions. Fleet managers reduce expensive breakdowns by replacing components at shorter intervals than needed. But this is an inefficient process as more parts are replaced before the end of their operational life. This inefficiency can be tackled with predictive maintenance. The vehicle's data, collected during regular operation, is used to estimate the true remaining useful life (RUL) of
components. With this information, fleet operators can gain a strategic advantage by optimally scheduling vehicle servicing to extend the operational life of parts.

Predictive maintenance is even more impactful in EVs due to their higher component and labour costs. With this technology in place, maintenance is more predictable and less expensive. The number of breakdowns is minimised, thus preventing costly downtime and expensive, unplanned trips to the workshop. Simply put, by pushing down costs and improving reliability, public transport providers will be able to make their vehicles run for longer, serve more people, and secure a return on their investment.

**Add in AI**

Technologies like predictive fleet maintenance platforms that use AI to provide real-time, actionable insight into the internal faults of electric buses allow maintenance managers to diagnose malfunctions remotely, without having to recall a vehicle off the road and physically look into it. An entire fleet can be monitored remotely, at any time and from anywhere.

The combination of large-scale processing, autonomous AI systems, and granular collection of vehicle data allow maintenance teams to fully leverage the data under the hood. The integration of AI solutions with connected vehicles and workshop information results in a feedback loop that feeds itself continuously and helps the system improve automatically during the fleet operation. This translates to higher quality failure prediction and continuous adaptation to new vehicles and automotive technologies.

**“Embracing predictive maintenance technology will not only smooth the transition into EV technology but also sustainably spearhead fleet operators into the next generation of e-mobility.”**

In addition to the maintenance challenges of EVs, their limited range can cause logistical problems to public transport fleet operators who need to plan routes and consider the maximum range the vehicle can do and the availability of chargers along the route. One recent study completed by the University of Halmstad and Caetano Bus goes far in addressing this issue. Advanced data analytics and machine learning models were used to build a
regression model that combines the battery data collected on-board the vehicle with other variables affecting vehicle range, and made it possible to accurately predict the present vehicle’s remaining range and the expected battery capacity loss over the next few years. The findings of the project have been implemented in a predictive maintenance solution in order to understand when the battery must be replaced or when the vehicle has to be operated with shorter routes. This provides public transport companies with the peace of mind of knowing with precision how their buses’ batteries are going to perform in one, two, or five years’ time. Fleet managers also benefit from an accurate prediction of the current range of the vehicle, calculated on the battery capacity and adjusted to account for the estimated capacity loss, as well as alerts for unexpected battery faults.

Mindful of the range losses in electric buses, public transport fleet operators may also make certain operational choices aimed at extending the battery life cycle and maintaining its capacity over time. Manufacturers offer guidelines on how to do that, but their main concern is to prevent excessive degradation during the warranty period. However, with proper usage, a battery should have a life that vastly exceeds the warranty period.
There are operational metrics targeted at extending battery life beyond warranty which should be monitored in real time within a platform, such as the State of Charge (SoC) optimality over time, i.e. the percentage of time spent at a healthy SoC range, typically between 20 and 80%. Another important metric is the Depth of Discharge (DoD), i.e. how much the battery is discharged between consecutive charges, which should be lower than 60% for maximum battery capacity retention. The fleet operator can visualise the SoC and DoD scores and understand if the operation profile can be changed to maximise battery life, reducing the total cost of ownership of electric buses. This type of analysis is fundamental for an operationally successful and profitable EV fleet deployment.

**Smoothing the transition**

Providing sustainable and accessible transportation which depends on the lowest possible cost per mile must be core to bus providers and their service offering. The lowest cost per mile can be achieved by extending the life of components, operating vehicles more intensively and for much longer hours while keeping them out of the workshop and on the road by eliminating downtime.

Empowering every fleet in the world with predictive maintenance to eliminate vehicle breakdowns and enabling reliable and on-time transportation services could save millions of people from the hassle of public transportation delays, postponed deliveries, or late arrival of essential goods due to the disruptions happening everyday caused by vehicle breakdowns and lack of visibility over a vehicles’ true condition. Embracing predictive maintenance technology will not only smooth the transition into EV technology but also sustainably spearhead fleet operators into the next generation of e-mobility.

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© Daimler Truck
The shift from internal combustion engines (ICE) to electrification is demanding a radical transformation for many automotive suppliers. Those that move quickly enough could find themselves playing in a lucrative space with tremendous growth opportunities; those that don’t could be out of the picture entirely.

Fluid handling specialist TI Fluid Systems (TIFS) is in the midst of a product portfolio shift and has been repositioning for an electric future under the business strategy ‘Take the Turn’. Central to this transformation is the establishment of a network of E-Mobility Innovation Centres (e-MICs), designed as locations to spotlight its growing capabilities around electric vehicle (EV) fluid requirements. The idea is that customers around the world can visit the e-MIC in their region to discover how TIFS could help improve the performance, cost and efficiency of their EV products.

“We are taking you on a journey behind the scenes of this pioneering facility to show what the future of fluid handling will look like,” Chief Executive and President Hans Dieltjens told media at a tour of the first e-MIC location in Rastatt, Germany.

Officially opened in March 2022, this facility will be joined by four more—in China, Korea, Japan, and the US—before the end of 2023. While each location will have a regional flavour, they will essentially provide the same service. “In terms of content, we are finding that customer needs are very similar in all markets,” Chief Commercial Officer Stephanie Jett told Automotive World during the site tour. “By having local centres, we can really shorten development time and bring product to market much faster.”

The focus is squarely on the next generation of thermal management systems, modules and components for EVs. “The EV transformation is already in full swing,” asserted Chief Technical Officer Johannes Helmich. “Our customers’ challenge is to rapidly transform their product portfolio from ICE to EV in super quick time—if possible, by yesterday. We have set ourselves the goal of actively shaping the future of...
electrification by providing full support to our customers.”

Notably, it offers full support in one centralised location. Engineers at Rastatt can design, develop, visualise and test new systems all under one roof. The unit is particularly proud of its virtual engineering capabilities, which include a huge high-resolution LED screen—measuring 9 meters by 2.5 meters—for 3D simulation. Engineers can use the 9-megapixel panel to evaluate a specific vehicle architecture for thermal behaviour in different configurations.

The site can also design components and systems and 3D print prototypes of them in a matter of hours. Product testing and vehicle testing are also carried out at the location. All of these tools are used to ensure that a specific design is verified—and verified quickly—with the data to back it up.

“The e-MIC is so important because it enables TI to work effectively and efficiently with customer by reviewing the EV challenges and providing innovative thermal management solutions,” added Helmich. “From 3D simulations to fully integrated hardware solutions, it is all under one roof.”

From a commercial perspective, the e-MICs could carry significant weight as a statement of intention. “Putting strategy on a piece of paper and showing that to a customer is one thing,” says Jett. “Bringing the customers here to the e-MICs gives a whole different flavour to how serious we are about making the transition to e-mobility. It steps up the game visually of what our intention is.”

TI Fluid Systems has about a century of experience within automotive fluid systems, but most of that is based on an ICE architecture. These e-MICs signal its mission to embrace the EV shift and pioneer technology innovation. Like most suppliers, TI wants to be seen as a pivotal source of know-how and technology leadership, creating what Jett refers to as a “mutual need for customer to want us and for us to want them.” To get there, though, it won’t be enough to simply follow the market trends; it needs to lead. Referencing her industry experience at the likes of Valeo, Visteon, Autoliv and Metaldyne, she notes: “One thing I learned over the years is that, regardless of commercial position, you have to lead with innovation. The first foot forward has to be innovation.”

Jett is part of a new wave of management, as both she and Dieltjens took on their current roles just a year ago. This fresh perspective and direction, she suggests, has been invigorating the company and supporting that technology leadership mentality: “We can’t do things as we’ve always done them. That applies from a technology perspective as well as an operational and commercial perspective. We must start doing things in different ways.”

The e-MICs personify that approach. With one open for business and four more on the way, the company is confident these one-stop shops will position it as a trusted thermal management partner in the race to an electric future.
The development of advanced driver assistance systems (ADAS) and autonomous driving is reshaping the in-cabin experience. Innovative perception systems drawing on sensors and cameras are at the heart of new functionality.

AutoSens Brussels 2022 offered a glimpse of where the industry is heading with the latest advances in perception, image processing, and connectivity. Automotive World reports back on some of the key displays from the event and how they could shape the cockpit of the future.

**Occupant monitoring with Omnivision**

Driver monitoring systems have been making a significant contribution to vehicle safety, but the benefits are now expanding to all vehicle occupants. Breaking new ground on this front are Smart Eye and Omnivision, which recently launched a combined solution for greater accuracy in automotive interior sensing. The system pairs Smart Eye’s algorithms for interior sensing AI with Omnivision’s next generation RGB-IR BSI global shutter sensor for in-cabin and occupant monitoring systems.

“We are only at the start of cameras inside the cabin, so the features this can enable are evolving very
quickly,” says Andy Hanvey, Director of Automotive Marketing at Omnivision. That list includes safety aspects, such as monitoring the state of the driver for drowsiness or distraction, as well as comfort features like seat position, adjustment of heating and lighting, and new multi-modal ways of interacting with the human-machine interface (HMI).

“The ultimate aim, says Hanvey, is “to be able to monitor the whole cabin and all occupants in it to gain deep insight into the complex states, behaviours and activities of people in a vehicle.” For Wilke, it’s a combination of saving lives and providing engaging mobility experiences that enhance wellness, comfort and entertainment. “The Holy Grail is to have occupants leave the car with a ‘wow’ experience, and to keep this experience fresh over the lifetime of the car by adding new features iteratively with over-the-air software updates,” he notes.

**Image enhancement with Visionary.ai**

A number of exhibitors at AutoSens addressed the issue of image enhancement. Vehicle perception systems are often capturing insights
in challenging conditions like low light or heavy rain. Developers have been ‘de-noising’ images with AI for years, but work has focussed on still images, not video. Visionary.ai has developed what it claims is the world’s first 100% software image signal processor technology that leverages AI on the edge, improving camera image video quality in almost complete darkness. And most importantly, it’s done in real time.

One of the most direct applications is for driver and occupant monitoring systems. “If we can enable these to work with tiny amounts of ambient visible light, then that would add a lot of value,” says Oren Debbi, Chief Executive and Co-Founder at Visionary.ai. “We also see the emergence of in-car video conferencing and gesture control, and those are also going to require image sensors in low light.”

AutoSens 2022 marked the launch of its AI-based Video Denoiser for improved night vision in real-time, for both human and machine vision applications. In comparison with other approaches to noise reduction, Visionary.ai claims its closest competitor took 212 times longer to execute, making it ineffective for real-time vision applications.

Despite the Denoiser’s advanced technology, Debbi still sees room for improvement and points to the James Webb space telescope as “pretty much the ultimate machine.” This six-meter mirror and cryogenically cooled sensor, he notes, is “fantastic proof of what is possible, but at a cost of US$10bn and the size of a house, we will have to look for something a little more pragmatic. For us, it is a question of how much noise can be removed and therefore how much performance obtained from a tiny, low-cost mass-produced sensor.”

**Connectivity with Valens Semiconductor**

Connected technology is rapidly making its way into new vehicles, reshaping the services on offer in the cockpit. Statista estimates that there will be more than 400 million
connected cars on the world’s roads by 2025. Israeli semiconductor company Valens is helping to provide high-performance connectivity in vehicles and believes that its long-term success hinges on the industry embracing MIPI A-PHY: a new global standard for long-reach sensor connectivity.

“New in-cabin features—whether they be oriented around safety like driver monitoring systems or entertainment with the HMI—require the distribution of massive amounts of data and video across the vehicle,” explains Gideon Kedem, Senior Vice President and Head of Automotive at Valens. “In addition, the applications involved rely on the integration of multiple sources of video and data. This requires, among other things, advanced sensor fusion capabilities. The MIPI A-PHY standard is undoubtedly the best connectivity solution enabling a high level of integration and advanced sensor fusion capabilities.”

Featuring 16 virtual channels and offering unprecedented bandwidth and link distance, A-PHY is designed to easily handle connectivity of the highest resolution sensors on the market. In addition, A-PHY chipsets offer the most advanced time-based services, including both clock and frame synchronisation, which are pivotal for sophisticated sensor fusion. “For years now, the industry has been calling for an upgrade to the analogue-based proprietary in-vehicle connectivity solutions to a standardised, high-bandwidth, error free, zero latency connectivity solution,” Kedem tells Automotive World. “Most importantly, the new solution needed to have flawless EMC performance, given the industry trends toward software-defined vehicles, autonomous driving, and electrification, all of which introduce added electromagnetic noise on the vehicle. That solution has arrived.”

Backers of the technology point to its resiliency and claim it offers best-in-class EMC performance, orders of magnitude lower than competing solutions. It is scalable, supporting up to 16Gbps links, with a clear roadmap to ultra-high bandwidth. Big names including Mobileye, Sony, Denso, Sunny Optical, Aptiv, Omnivision, Sumitomo, Leopard Imaging, Keysight, and LG Innotek have all publicly endorsed the technology, and many are in the process of creating A-PHY-based systems. “The Holy Grail of in-car connectivity is arriving sooner than people expected, and it is delivering the hardware foundation for the software-defined vehicles of the future,” Kedem adds.

**A glimpse of what’s possible**

These are just a tiny snapshot of the technologies on display at the event, but they capture the growing importance of sensor technology as the industry incorporates greater levels of ADAS and autonomy. Whether driven by a human or a computer, vehicles need to accurately detect their exterior and interior environments and will almost certainly draw on connectivity for some features. Each player has its own idea of what represents the Holy Grail of their specialised area, be it connectivity, image enhancement, or occupant monitoring. Where this takes the cockpit of the future remains to be seen, but AutoSens Brussels 2022 offered a glimpse of what could be possible.
Automotive manufacturing projects have grown increasingly complex over the years as companies respond to new technology trends, such as in-car connectivity and electric vehicles (EVs). The pressure for project managers to come in on time and within budget has never been higher.

**Cost and time**

In many cases, teams are bringing technologies into mass production for the first time. Key components like electric motors (e-motors), power modules and batteries are all in the early stages of development and don’t necessarily have the maturity to hit mass production manufacturing KPIs.

Digital manufacturing management technology underpins smart, electric vehicle development. By Megan Lampinen
“These products entail many inefficiencies at the beginning of the process,” says Ignazio Dentici, Vice President for Automotive and eMobility Industry for Hexagon Manufacturing Intelligence. “You end up with a lot of scraps and you struggle to meet the cycle time originally set out. This makes it harder to stick to the time and cost targets.”

Automakers are also struggling with supply chain challenges, specifically shortages, bottlenecks and general uncertainty. “The supply chain issues over the past two years have been a huge headache for project management,” he adds. “How do you maintain volumes and timing KPIs when you have a lack of electronics or raw materials? Project management has evolved from a team leadership role to one of complex change management.”

Hexagon is helping to make the process of manufacturing project management smoother by enhancing collaboration and innovation, and facilitating the better use of data in production and across product lifecycle. It sees the use of digital twins and digital reality as pivotal tools in building more agile and flexible production processes, all ultimately helping automotive manufacturers make better decisions. All of these aspects feed directly into the project managers’ responsibilities for bringing in a project on time and within cost.

**A measurable impact**

This is where a smarter set of tools comes in handy. Companies are turning to digital twins, virtual reality and enhanced collaboration to help. Broadly speaking, everyone wants to make better use of data. While greater amounts of data are becoming
Hexagon has supported Skoda in reconfiguring its inspection processes for 3D optical systems as it moves away from tactile measurement available both from the development process and manufacturing operations, the key is to leverage it and interpret it through artificial intelligence (AI). “You need to make this data easily understandable in terms of the decision-making process for the project manager,” emphasises Dentici.

Simply working on a common team platform could make a huge difference. Vehicle manufacturing projects involve numerous suppliers, located in different parts of the world, and they all need to cooperate in real time. Teams are also dealing with hybrid working, with some employees at home and others at the office. A single project team can also involve employees from different regions. “It’s not easy to keep the team all together on the same target when you have so many geographical, cultural and time zone differences,” Dentici tells Automotive World.

Hexagon’s digital platform Nexus facilitates just that. It connects people, technology, and data across the design, production and manufacturing workflow to facilitate information sharing, improve quality and optimise operations. The streamlined approach is specifically designed to empower cross-functional teams with the necessary insights to solve challenges and collaborate instinctively in real time.

The company’s digital twin technology is helping from a different angle by cutting overall development time and cost requirements for physical prototypes. “This is really addressing the complexity and
expense aspects of project management,” Dentici notes. Similarly, quality management systems are optimising established manufacturing processes and providing feedback to improve the next generation of products.

Such approaches can have a considerable impact. Valeo used Hexagon digital prototyping software to design a new e-drive, and found it reduced the time to market from two years to 18 months, a notable 25% savings. Audi, meanwhile, found that it can halve the time it takes to complete body-in-white testing using Hexagon measurement scanning tools. Similarly, Skoda has found that Hexagon’s robotic automation software allows it to programme the robotic inspection progress in just four hours, down from several days. All of these things make companies more agile in their manufacturing processes.

**Where next?**

While the current offering clearly provides benefits, there is always room for improvement. Dentici specifically flags the need for more autonomous processes within project management: “Autonomous projects provide data for change management processes or for taking decisions in a clearly autonomous way. Here, the project manager uses their time to make the decision-making process and not to evaluate the data. The data is automatically evaluated by the tools.”

Looking ahead, he sees a growing trend towards greater agility in development and manufacturing, enabled by automation and digital processes. “A team can now easily change a decision without impacting the overall development and manufacturing chain,” he notes. “In the past you may have needed to start again from scratch, but now it is much easier to change something.”

For instance, imagine there is an unexpected scarcity of a specific raw material. A company can then turn to Hexagon’s material modelling platform Digimat to see if there’s an alternative material they could use. “This gives an agility to the project manager to take a decision to change the material without having to affect all the process validation,” he explains. “All this flexibility of design and manufacturing is enabled by the digital world, and all of these offer room for improvement for manufacturing project management.”

At the end of the day, project managers are responsible for programme timing and costs. Tools from Hexagon and others like it will prove increasingly important as teams scramble to implement new technologies in their product line-ups within shorter product lifecycles.