Lotus evolves car design to reflect electrification | Divergent revolutionises manufacturing approach | Nexgenna project accelerates sodium-ion batteries | Cobalt Institute fights back against negative publicity | AUTOSAR partnerships tackle key autonomy questions

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AUTOSAR partnership key in tackling the big question around autonomous vehicles

Does Canada have what it takes to become a global EV innovation hub?

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Cover image courtesy of Lotus Cars
Are customers ready for EV-centric car design?

Lotus provides insight on how vehicle design can evolve to reflect the electrification of the automotive industry.

By Will Girling
Mobility is on the cusp of its most significant transformation in recent memory: the shift from international combustion engines (ICEs) to electric vehicles (EVs). Hastened by regional targets banning the sale of new ICEs by 2035, the change has advanced with such speed that some in the automotive industry have been caught off-guard.

Arguably, it is the design of contemporary light EVs that betrays how unprepared many automakers have been for this new era. The three-box body configuration—which accounts for the three main components: engine, passenger, and cargo—long associated with ICE coupés, sedans, and hatchbacks remains largely intact. This is despite the fact that engines need no longer factor into the design. Subsequently, many EVs are aesthetically identical to their ICE forebears.

**Taking design out of the past**

Ben Payne, Managing Director and Head of Studio at Lotus Tech Creative Centre, tells *Automotive World* that the time is right for the industry to evolve. “Three-box designs are essentially just an evolution of the horse-drawn carriage. That silhouette evolved into the motor car, but Lotus is breaking away from that.” The company, he says, doesn’t want to follow the trend of simply removing the engine and converting the cavity into storage space. Instead, it is aiming for something more ambitious.

There is a reason: to emphasise its shift to being a fully electrified brand, Lotus is focusing on using the inherent strengths of an EV’s powertrain and dynamics. For example, no engine means the Lotus Eletre SUV can feature a large wheelbase, short overhangs and a cabin brought forward. The result is a proportional shift and much greater space for occupants front and back than would be possible in an ICE.

That isn’t to say that the trademark Lotus styling, with which customers will be familiar from its ICE vehicles, has been abandoned wholesale. “If you look at the Eletre, it still has a fast frontend and a peak in the roofline that falls away quickly, which you’d normally associate with a mid-engine car.” Payne adds that this similarity is important: it marries the lineage of what people expect from a sports car with the best that electrification can offer.
Thinking outside the box

In terms of aerodynamics, being able to eliminate a large power unit from the front opens many exciting design opportunities. The Eletre features ‘active aerodynamics’—vents and ducts in the body that channel air through and over the vehicle. This “porosity”, says Payne, features responsive shutters and spoilers that can alter the Eletre’s handling, speed, and even range.

Not being encumbered with an engine also introduces more freedom from a designer perspective, even if it doesn’t necessarily make the process easier. “The electric drivetrain has a different mass and component layout. That means we can reorder design elements beyond the three-box configuration and challenge ICE-centric design in a whole new way.”

In fact, Payne believes that designers will be able to envision the future look of mobility before engineers and manufacturers. “I don’t think designers will need to be retrained, but they will need to think back to the early years of their career—before they were limited by their knowledge of engineering.” In an industry that has slowly evolved for over a century around ICEs, he doesn’t doubt that a mindset shift will be required for the electric era. However, it might be the customers themselves who most need to adapt.

Meeting expectations

When he considers why so many OEMs are conservative about changing the designs of their EV offerings, Payne concludes that customer expectation is the primary reason. “If every automaker suddenly produced vehicles that were radically
different, I think they’d struggle to engage customers.” Even though designers might be willing, asking the market to take on new technology—the EV powertrain and the logistics of vehicle charging—as well as new aesthetics could prove alienating.

More than ever, manufacturers must align their designs with their brand image and growth strategies. If a company is a household name known for reliability and down-to-earth functionality, Payne thinks it would be unwise to contradict that perception, at least for now. “As the EV market grows, you’ll start to see some more expressive designs. But that won’t just be because of designers; it will be because the acceptance of customers will allow it.”

For Lotus at least, the ability to push beyond the status quo stands it in good stead to become an early pioneer of truly EV-centric design.

The car of the future

For the moment, it seems like the evolution of car design will be a gradual process; the familiar ICE vehicle structure is so ubiquitous that it will prove...
resilient to change, even when its original utility is lost. “Progress will be uneven across brands,” says Payne, “For a long time, there’s been a perception that all cars look the same, but electrification will slowly introduce different silhouettes and diversification.”

Based on Lotus’ example, a trend towards different proportions, new aerodynamics, and larger wheelbases could become more common as automakers seek to maximise space. Because many initial forays into EVs have centred on the lifestyle and SUV markets—such as the Kia EV6, BMW iX, and the Ford Mustang Mach-e—vehicles might also become taller in the short term. Payne adds that the size of these vehicles facilitates more battery space and therefore increases range, which is still an important consideration for customers looking to buy their first EV.

However, this is not to say that batteries will cause restrictions. “The development cycles are super-fast. You often see iterations between projects, so the height will probably lower as batteries become more powerful and compact.” The amount of electronic content within the car is also likely to bloom, with automakers seeking to incorporate the digital connectivity of customers’ daily lives into the driving experience. While this might not seem directly related to design, Payne believes that EVs will become entwined with daily life much like a smartphone. As such, this merge will ultimately shape what goes into the car itself.

Clearly, the shift to EVs represents one of the most exciting opportunities in car design in recent memory. As electrification changes how we drive and interact with cars, the familiar shapes we know so well may gradually morph into something that genuinely reflects the needs of drivers in the digital age.
Tata Motors: India is on the cusp of a new epoch of mobility

Speaking with Pankaj Jhunja from Tata Motors, Will Girling explores how the Indian automotive sector is changing in the electric era

Following two of the greatest existential challenges in its history—the COVID-19 pandemic and the shift to electric vehicles (EVs)—the Indian automotive industry is poised to transform in a significant way.

Ranked by market data specialist Statista as the fourth-largest vehicle producer in the world by volume in 2021, India’s position as an innovative market leader has been bolstered by its commitment to electrification. The government’s Faster Adoption and Manufacturing of (Hybrid and) Electric vehicles (FAME) scheme has provided cash incentives on a national and state level for those seeking to move away from internal combustion engines (ICEs) since April 2019. FAME appears to be bearing fruit—The Time of India reported in March 2022 that EV registrations totalled 3.25 million for 2021, a 163% increase on 2019’s figure.
Tata Motors has been front and centre of India’s newly electrified vehicle market, producing modern, innovative, and eco-friendly cars. More than that, however, is its desire to create affordable vehicles and interact with new business models that can broaden transport accessibility in the EV revolution. Pankaj Jhunja, Senior General Manager of Mobility Services at Tata Motors, shared insights with Automotive World on how this is being accomplished.

**Fleets transformed**

Market reporter Research and Markets.com expects India’s shared mobility fleet to increase from 7 million vehicles to 9.7 million by the end of 2022. Poor public transport infrastructure and the desire to practice social distancing during COVID-19 laid the foundation for this growth. “Tata Motors is serving this category through its XPRES T EV sedan,” says Jhunja. “It offers lower cost of ownership and a partner ecosystem that includes charging through Tata Power, financing through Tata Motors Finance, and battery engineering and warranty support through Tata Auto Components.” Two versions of the vehicle are available, with the largest possessing a certified range of 213km from its high-density 21.5kWh battery.

Priced at US$12,000 to US$13,500, the XPRES T EV is slightly cheaper than the average price for a new EV in India—US$15,000. Indeed, the Tata model represents a holistic customer solution that will be vital for encouraging companies to update their fleet, but it also indicates another important factor for EV uptake: affordability.

The result we’re seeing is a lot of drivers moving out of the business after the initial euphoria of joining the electric vehicle revolution.
Released in July 2021, it didn’t take long for ride-hailing to realise the XPRESS T EV’s value proposition. In June 2022, BluSmart Electric Mobility placed an order for 10,000 units, a quantity which, combined with the 3,500 it had ordered the previous October, ranks as the largest EV fleet in India to date. “We are building a large-scale integrated EV mobility ecosystem in India,” said BluSmart Co-founder Anmol Singh Jaggi. “With the increasing fleet size, we are leading India on the path to reliable, sustainable and zero-emissions mobility and also creating more inclusive and economic opportunities for driver partners.” As such, by partnering with digital innovators like BluSmart, Tata Motors is making a direct impact on the future shape of Indian transport.

**Market penetration**

In Jhunja’s view, while there are no significant barriers for EV uptake in the Indian market, the speed at which market penetration can be hastened is constrained by challenges typical of new technology—namely the risk of the unfamiliar. “Stakeholder comfort with EV technology needs to reach critical mass for new investments to be justified. As EVs reach price parity with ICEs, the returns on total cost of ownership savings will be realised quickly.” Jhunja concludes that this will accelerate momentum and add to service longevity.

Market research company Grand View Research (GVR) estimates that the Indian EV market was worth US$220m in 2020. Assuming a compound annual growth rate of 94.4% between 2021 and 2030, the total valuation could be in excess of US$150bn in just eight years. GVR forecasts that a period of exponential growth will take place between 2024 and 2026, suggesting that Jhunja’s assessment of short-term investor hesitancy could be correct and about to end.
Meanwhile, Tata Motors is also continuing to expand its stable of low-cost EV offerings for the private ownership market—the Tata Tigor EV was released in August 2021, while the latest version of the Tata Nexon EV (MAX) debuted in May 2022.

**Challenges to the transformation**

Looking ahead, Jhunja considers the difficulties of scaling India’s new EV-based transport solutions to be three-fold: the customer experience, stakeholder empowerment, and the costs associated with developing each. Prospective consumers must not be alienated by new vehicle prices, and the case for EVs offering an equivalent level of value to ICEs must be stated firmly.

With the Indian market on the cusp of such a transformational epoch, it is wise to acknowledge the prominence that shared mobility might gain in a newly electrified market. However, Jhunja states that this will have its own distinct customer challenges: “In India, there is a different vehicle registration process for personal versus commercial use.” Tax implications, licensing differences, and angst in the driver community regarding high commission rates from service providers combine to create a difficult operating atmosphere. “The result we’re seeing is a lot of drivers moving out of the business after the initial euphoria of joining,” he continues.

Income loss as a result of the pandemic might make ride-hailing more cost effective for customers, but the same financial pressures are acting on vehicle operators themselves.

Clearly, affordability will be key for all stakeholders as the Indian market shifts to EVs and new operating models. Whatever the outcome, Tata Motors is placing itself at the frontier of an exciting time in the automotive industry’s history.
Sodium ion alternative has automotive application as lab results deliver promise

The argument for sodium use is beyond appealing—it’s positively compelling, writes Cat Dow
As battery development in the automotive space continues, the ubiquitously available sodium purports to make gains in cost, safety, scalability and sustainability.

Led out of the University of St Andrews and working in partnership with Faradion (a company established in 2011 to develop and bring sodium-ion battery technology to market), a wide network of industrial collaborators, five UK universities and other overseas institutes, the Nexgenna project aims to ‘accelerate the development of sodium-ion battery technology by taking a multi-disciplinary approach incorporating fundamental chemistry right through to scale-up and cell manufacturing. Its aim is to put on the path to commercialisation a sodium-ion battery with high performance, low cost, that has a long cycle life and is safe.

Lead investigator Professor John Irvine told Automotive World, “Many of us in the [scientific] community thought lithium was always going to be more effective [than other elements]. [Yet, the performance of] sodium is rapidly becoming comparable to some of the best lithium technologies. [What’s more, with sodium] you can avoid using cobalt, you can avoid lithium.”

Making cost savings through sustainability

The argument for sodium use is beyond appealing—it’s positively compelling. The bill of materials (BoM) for sodium-ion chemistry is some 70% of that of LFP batteries. In a world where supply chain disruptions are affecting global economies, the idea of using an element base that is universally accessible offers a security that cannot be guaranteed with lithium. In addition to the lack of cobalt, there’s also no copper current collector required in sodium batteries either. In stripping out elements that are potentially insecure to obtain and transport, sustainability, scalability and safety are also key advantages of using sodium-ion batteries.

There are many advantages inherent in the [sodium] technology. We are trying to bring the performance levels up to where it can fill certain market applications where lithium may struggle

Irvine is keen to stress that the project doesn’t seek to wholly replace lithium-ion or LFP battery chemistries, but instead seeks to provide a complementary alternative competing in a global market, set to grow exponentially over the next decade. Irvine continues, “There are many advantages inherent in the [sodium] technology. We are trying to bring the performance levels up to where it can fill certain market applications where lithium may struggle, not at least in terms of volume.”
Finding parity in performance

With sales of electric vehicles (EVs) set to increase, manufacturers, suppliers and research institutions, such as the Faraday Institution, are investing in exploration into other battery chemistries and even alternative battery physics. The Faraday Institution, with its ‘beyond lithium’ campaign, is behind the £11.5m (US$14.2m) funding for the Nexgenna project.

Giving an appreciative nod to his colleague Dr Robert Armstrong who believed in the application of sodium-ion before many other colleagues were convinced, Professor Irvine sounds understatedly thrilled about how the project’s results will apply to automotive, “It’s looking very promising all of a sudden. The performance levels are lower at cell level, but in terms of pack, it’s looking very promising. In the same way that lithium iron phosphate (lithium ferrophosphate or LFP) is now coming to dominate, [our research shows] the performance of LFP batteries is not that far ahead of where sodium-ion batteries are at present.”

Improving safety

When batteries in EVs account for 30% of the vehicle weight, one wonders if sodium-ion batteries will help with reducing the weight in vehicles. Dr Armstrong explains, “Lithium iron phosphate and sodium-ion are fairly comparable in terms of gravimetric energy density. Once you start talking about volume then LFP’s not a very dense material. So in theory, you can at least match the performance, in terms of volumetric energy density with sodium.”

While sodium may not prove especially advantageous on the weight front, it’s no worse. And it doesn’t carry the other risks associated with lithium either. Professor Irvine says, “Some of the really exciting lithium technologies have heat management issues. So you could have more energy in there, but then you have to cool. It’s much, much harder to cool. That’s where these less energy dense materials [like sodium] are actually coming up trumps—if they’re losing less heat, they’re also more efficient.”

Multi-disciplinary approach

As the mission stated, there is a ‘multi-disciplinary approach’ to the Nexgenna project. Across the network of research partners involved in Nexgenna, computational insights, gauging synthetic experimentation, studying ‘ageing phenomena’ to better understand battery degradation and engineering the solid electrolyte interphase (SEI) differently make up the ways in which Nexgenna
A University of Cambridge-based team is finding a new route to ensuring battery-grade sodium electrolytes. Commercial NaPF6 is expensive and has a high amount of impurities, affecting the quality of the electrolyte and its capacity to perform. Purification adds time and cost. Yet, by combining sodium metal, ammonium PF6 with tetrahydrofuran (THF) and negating the need to use fluoride (HF)—usually used in these procedures—Dr Svetlana Menkin and the team have succeeded in making ‘Cambridge NaPF6.’ Purer, eliminating degradation and prepared in a twelfth of the time taken to purify commercial salt, the results of Cambridge salt have shown parity in conductivity, stability and life cycle with that of commercial salt.

Meanwhile, screening composites based on hard carbons, the Lancaster University-based ‘HIPERCARB’ investigation explores possible anodes for sodium-ion batteries, targeting cell-level energy density and cost reduction, as well as optimising the anodes for pouch cell packs, rather than cylindrical configuration. Such case studies demonstrate the breadth of Nexgenna.

**Scaling up**

When it comes to battery manufacture, Professor Irvine explains, “It’s not just about producing, [for example] a cathode. It’s about being able to reproduce that cathode configuration on a mass scale, with unwavering precision. It’s not enough for it to be ‘kind of like’ the last cathode, because the chemistry in the battery needs to be predictable. We need to be able to know that when we changed that [component] slightly, that worked.”

Enabling the team to replicate their successes to perfection, a new scale-up facility at St Andrews’ Eden Campus in Guardbridge is opening in July 2022. Powered by its own solar farm, the new facility includes a roll-to-roll coater and dry room, and enables cell assembly and cell formation at scale.

Professor Irvine says the plan is to use the dry room interchangeably between sodium and lithium. This offers yet another persuasive pro to the sodium battery development narrative. If the existing infrastructure for manufacturing Li-ion and LFP can be utilised for sodium, the commercialisation of these technologies will be a no-brainer.

In fact, CATL, a Chinese battery company specialising in the manufacture of lithium-ion batteries, plans to commercialise sodium-ion batteries in 2023, coinciding with the next phase of Nexgenna project funding. Professor Irvine says, “The exciting thing is that the technology is working a lot better than we might have expected. The new prototype should be able to displace lead acid batteries from their current uses, be more cost-effective than lithium-ion in some existing applications and enable the electrification of new markets.”

The argument for sodium use is beyond appealing—it’s positively compelling.
An inside look at liability in the era of autonomous vehicles

What happens when the driving experience becomes automated such that the action or inaction of the vehicle itself leads to an accident? By David Cummings and Lauren Gubricky
As automated driving systems become increasingly standard across the automotive industry, they continue to grow in sophistication, expanding from the automation of discreet tasks in confined circumstances (self-parking, automatic braking systems) to more advanced, all-encompassing mechanisation of the driving experience. Indeed, these technologies are leading a monumental shift from human-controlled to vehicle-controlled driving experience.

But with this shift comes important questions of liability: what happens when the driving experience becomes automated such that the action or inaction of the vehicle itself leads to an accident? Traditional vehicle collision coverage is premised on the supposition that an accident is a result of the driver’s action or inaction. Unless there are circumstances that suggest the vehicle or its component parts were designed, manufactured, or assembled in such a way that caused the accident, or at a minimum, in such a way that increased the scope of injuries, vehicle manufacturers and developers are omitted from questions of liability.

Although it is possible that such insurance continues to respond to incidents involving autonomous vehicles, victims are also likely to point a finger in a different direction: towards the companies whose automated processes failed to prevent—or as some may argue, directly caused—the accident.

A changing legal landscape

As autonomous technologies advance and begin to supplant driver decision making processes, courts are increasingly tasked with assessing the scope of manufacturer and developer liability when accidents occur. In late 2020, the family of a man who was struck and killed by a vehicle filed a lawsuit in California which sought to hold the manufacturer liable for defective design and failure to warn of alleged defects of its self-driving technology and driver assistance features. This case came on the heels of a similar suit which had been filed earlier that year in Florida. There, the plaintiffs sought to hold the vehicle manufacturer liable for damages related to a collision that the plaintiffs alleged was the result of the failure of the vehicle’s driving assistance technologies. These cases, and others like it, underscore the risk that victims are likely to pursue claims against vehicle manufacturers and developers for such incidents.

Such liability exposure is compounded by a recent shift in judicial thinking regarding software as a “product” for purposes of product liability litigation. The court in Holbrook v. Prodomax Automation recently addressed this previously-untested theory when it held that the software at issue was subject to principles of product liability because it was an “integral” and “essential” component of the injury-causing machinery.

The added risk of cyber attacks

Companies of all sizes are undoubtedly familiar with the ever-growing risk of cyber-attacks that can compromise the integrity of operational systems. Unfortunately, this risk can also extend to vehicles themselves, creating yet another layer of potential liability for autonomous vehicle manufacturers and developers.

Such risks were illustrated as far back as 2015 when security researchers were able to hack into a vehicle as it was driving, manipulating its systems and ultimately...
sending it into a ditch. Accordingly, industry experts have expressed ongoing concerns surrounding the infiltration of autonomous technology to cause an accident, creating liability risk even where technology is otherwise operating as expected.

**Insurance implications**

In the wake of a potentially major shift in liabilities, businesses involved in all stages of production of autonomous vehicles must take a careful look at their respective insurance programmes to assure they adequately reflect this growing and changing risk landscape. Although there are multiple insurance products that may cover costs and liabilities arising out of such lawsuits, this article focuses on three of the most common types of coverage: general liability, product liability, and cyber liability insurance.

**General liability insurance**

Most companies purchase general liability insurance as a part of their broader insurance programme. General liability policies provide broad coverage for “property damage” or “bodily injury” to third parties caused by an “occurrence,” often defined as “an accident.” This type of coverage usually requires the insurer to retain counsel and defend the insured in an underlying lawsuit (the “duty to defend”), and pay for any judgments, settlements, or other liabilities (the “duty to indemnify”).

General liability policies may indeed provide coverage for costs and liabilities associated with a product liability lawsuit where accidental bodily injury or property damage occurs. That said, these policies respond to all types of third-party suits, so it is important to consider your company’s risk profile inclusive of product liability considerations and determine whether or not you are adequately insured.

Further, general liability policies might contain coverage exclusions that insurers will point to as grounds for denying, or limiting, coverage for product liability-related costs and liabilities, particularly if product liability issues were not anticipated when negotiating coverage. For example, to the extent product liability damages involve damage to a business’s own product or operations, the insurers may point to the oft-included “your work” and “your product” exclusions, designed to ensure coverage is limited to third-party damages only. In addition, many general liability policies contain “sistership” exclusions, intended to preclude coverage for damages related to product recalls, a common—and often costly—component of product liability incidents.

**Product liability insurance**

Although general liability policies may provide a safety net for a product liability lawsuit, depending on a business’s exposure—particularly in light of increased liabilities for software developers in the wake of Holbrook—it is worth considering insurance that is specifically tailored to product liabilities.

Product liability insurance is often purchased as a part of a broader general liability policy, but can also be purchased as a separate insurance product. This type of coverage is often referred to as “products completed operations” or “completed operations...
hazard” coverage. Although this coverage may overlap with general liability coverage, it is also designed to explicitly encompass product liability-specific risks. Importantly, those exclusions discussed above may be omitted when specifically placing product liability coverage, effectively providing increased coverage for other categories of damages, such as product recall.

Of course, because this type of insurance is more narrowly tailored, it is important to confirm that your product liability insurance does not exclude coverage for software-related events; i.e., that it explicitly limits covered “products” to the hardware itself.

Cyber insurance

Generally speaking, cyber insurance policies include coverage for losses arising from data destruction, hacking, and extortion, which may include increased risks associated with attacks on vehicles. That said, it is important to underscore that cyber insurance is a heavily-tailored product, and offerings are becoming more and more limited as insurers pay a growing number of claims. Although some cyber policies include third-party coverages, many are limited to first-party losses, which would mean that it does not respond to product liability lawsuits. Businesses in the automated vehicle space should have explicit conversations with brokers and risk management professionals to assure policies adequately cover anticipated and expected risks.

As automated technologies become increasingly responsible for the operation of vehicles on the roads, companies operating in this space must be adequately prepared for increased liabilities. Accordingly, it is more important than ever to lean on risk management professionals, trusted brokers, and coverage counsel to evaluate product liability risks, review your business’s existing insurance programme, and negotiate coverages to ensure these developing risks are adequately insured.

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Can the electric revolution thrive without cobalt?

Cobalt has had its share of negative press, but the Cobalt Institute continues to champion the responsible use of this important battery material.
By Megan Lampinen

Cobalt is a pivotal component in today’s lithium-ion batteries, and plays a key role in electric vehicle (EV) range, safety and performance. The material is a by-product of either nickel or copper mining. Globally there is just one pure cobalt mine, which is based in Morocco and run by a company called CTT. The lion’s share of the world’s cobalt—about 75%—comes out of Democratic Republic of Congo (DRC), specifically the Copper Belt in the southern part of the country.

While incredibly useful in EV batteries, cobalt has attracted negative attention in recent years due to links with worker exploitation in Congolese mines. Some EV makers are keen to move away from the material, but would that be a mistake?

A paradigm shift

The Cobalt Institute believes it would. This is the global association representing the cobalt industry. Its members span the entire value chain, from the cobalt miners and refiners to traders, recyclers and downstream users. Its purpose is to promote the sustainable and responsible production and use of cobalt in all of its forms and applications. Today, batteries represent the single biggest application of cobalt, accounting for nearly 70% of all cobalt use.

Historically, the majority of cobalt battery applications went to the consumer electronics industry for use in portable electronics like iPads and laptops. However, that’s recently been overtaken by EV batteries. “Electrification of the vehicle fleets and to a lesser extent energy storage from renewable energy is very much driving the cobalt market. It’s a paradigm shift,” explains Adam McCarthy, President of the Cobalt Institute. While a phone or iPad uses mere
grams of cobalt, and EV will consume kilograms of the material. In the last five years the market has roughly doubled, and should double again through to the end of 2026 to somewhere around 300,000 tons a year.

Cobalt is present in two of the main EV battery chemistries on the market today—lithium-nickel-manganese-cobalt-oxide (NMC) and lithium-nickel-cobalt-aluminium oxide (NCA)—in varying quantities. It provides stability and durability so the battery can go through multiple charge cycles, as well as a high energy density. “What we see are batteries that are high-performance and can travel more kilometres per kilowatt-hour of charge,” says Tom Fairlie, Sustainability Manager at The Cobalt Institute. “Thanks to higher energy density, the battery has lower mass for its capacity and that should allow it to perform better.”

Without a decent range on offer, EV uptake may struggle to take off. Range anxiety is one of the leading reasons consumers say they would hesitate to buy an EV. “Ultimately, it’s cobalt-containing batteries that give consumers the range they’re looking for, particularly in the more developed markets such as Western Europe and North America,” adds McCarthy. China has recently seen growth in LFP chemistries, which typically have less range but are suited for smaller vehicles. Automakers selling primarily in Europe and North America are pursuing a mix of battery chemistries but the majority of high-range, mid-tier models feature cobalt-containing batteries for that energy density.

**Challenges**

Cobalt helps get the most out of battery performance but it has its drawbacks. It has been linked
to mines that use child labour and operate under unsafe work practices. Most of those instances stem from artisanal small-scale mining, which can be unregulated.

“These are things that the industry in partnership with civil society organisations and the Congolese Government is trying to address,” says McCarthy. Essentially, these groups want to see artisanal cobalt produced in a way that is responsible, so it can be put into the mainstream supply chain for wider use.

“There’s a knee-jerk reaction to think that if we stop using it, it will just disappear,” he warns. “These mines represent livelihoods for hundreds of thousands of people.” With no alternative work available in many cases, the aim is to ensure that these people can pursue that economic activity but in a sustainable, well-monitored manner.

On top of that, cobalt is expensive and availability is limited. However, the Institute is hopeful that both of those will issues will abate as new sources emerge and costs decline. There are new projects underway in Australia, which holds the second largest amount of proven reserves after the DRC. Activity in North America, particularly in Canada, is also taking off.

Figures from the US Geological Survey estimate that the DRC has around 3 million tonnes of cobalt in reserve and Australia around 1.6 million tons. “Australia has the ability to be a pretty significant supplier,” says McCarthy. Canada has significant reserves too, with over half a million tons. Zambia shares the Copper Belt with the DRC and has shown an interest in exploiting its mineral wealth, both copper and cobalt. Indonesia, through its nickel development, could also become a sizeable cobalt producer.

“We will see growth outside of the DRC, but geology is what it is and the DRC will remain a significant producer and supplier of the material,” McCarthy tells Automotive World.

Recycling and environmental footprint

Recycling should prove an additional source of cobalt in the coming years, as the EV fleet ages and expands and more...
batteries reach the end of their useful lifetime. “Recycling is going to be an increasingly important consideration with batteries as they come to end of life and in light of the increasing demand for materials like cobalt,” says Fairlie.

The European Battery Legislation is currently undergoing an update and in its new form will include recycling rates for battery materials such as cobalt, nickel, manganese and lithium, as well as reuse frames. Details are yet to be finalised, but the expectation is that it will require batteries to contain a certain percentage of recycled material. “The current number for cobalt is 12% of recycled material eight years after the legislation comes into force (the requirement anticipated around 2030), but those dates and those numbers may be subject to change,” notes McCarthy. That proposal is going through the final stages of the legislative process and will likely have a two-year implementation period.

The Cobalt Institute is actively involved in the Global Battery Alliance and the batteries Product Environmental Footprint Category Rules in Europe. Here it is looking at the carbon footprints of batteries and cobalt’s contribution to that. “Feeding into this work we have an ongoing lifecycle assessment now in its second iteration, looking at the cradle-to-gate impact,” notes Fairlie. He also points to work on a circular economy programme examining the in-use phase and end of life. The focus in on how cobalt can help contribute to circularity and a sustainable and responsible battery value chain.

Despite the progress being made and the work underway by The Cobalt Institute, a number of developers are looking to side-step the challenges around cobalt and are exploring cobalt-free battery chemistries. Today, they generally remain in the early development stages. “We have seen the so-called thrifting of cobalt, where you reduce the amounts of cobalt in nickel-driven batteries,” says McCarthy. In 2021, General Motors unveiled its Ultium battery packs, whose cells use a nickel-cobalt-manganese-aluminium chemistry but feature 70% less cobalt than current market batteries.

“We’ve not yet reached the point of very low amounts of cobalt, at least in the mass market,” he adds. “Cobalt-free batteries are hard to imagine.” That’s mostly because NMC and LFP are among the favoured chemistries and these are the batteries that the world’s Gigafactories are rolling out.

As for some of the cobalt-free developments under way, McCarthy argues that they are either “still in a laboratory” or have yet to be produced at scale. By the time they are ready for mass production, he expects the industry to have moved forward with the current battery technologies and simultaneously advanced its recycling capabilities. “Cobalt isn’t going to go anywhere, in our view,” asserts McCarthy.
Where next for connected mobility in India?

Connected vehicles could reshape mobility in the fourth largest automotive market in the world. By Megan Lampinen
The connected vehicle and the business models it empowers could revolutionise mobility in markets around the world. Offering its own connection to the internet and equipped with advance communication technologies, these vehicles can share data with other devices. The use cases offer new levels of comfort, safety and convenience as well as lucrative revenue streams.

When it comes the numbers of vehicles with connectivity, China, Europe and the US lead the pack. However, some of the highest growth rates are seen in India. This market is of massive global importance for mobility players. It recently overtook Germany to become the fourth largest automotive market in the world and some industry watchers estimate that one in every four cars in the country could have 5G connectivity by 2025, by which time connected cars will represent 5% of all connected devices.

**The current state of play**

“Growing demand for a more intelligent and secure solution gave rise to connected technology, which has since taken centre stage in the Indian vehicle market,” says Sudip Saha, Chief Operating Officer at Future Market Insights. “The demand for connected technology is causing rapid change, and connected cars are no longer a luxury dream.”

A study from Quanzen estimates total number of connected cars in India in 2022 at around 1.7 million, up from 300,000 in 2016. Others put it higher. Alexandre Audoin, Head of Global Automotive at Capgemini, and Head of Automotive at Capgemini Engineering, cautions that it is difficult to pinpoint an exact figure. “What we can say with certainty is that India is taking a unique position in developing the next big frontier for connected cars,” he tells *Automotive World*.

“More recently we’ve seen a wave of collaboration between OEMs and third-party providers as automotive organisations look to leverage external technology expertise from the likes of network operators, cloud service providers, and hardware developers,” he adds. Tata Motors offers a good example: the automaker has partnered with the app-based freight logistics company TruckEasy, which has provided insight into the freight logistics space.

The connectivity within these vehicles opens the door to numerous connected features and services. “Mainstream automakers have been offering connected features for the past few years, but the specific services and features vary as from model to model,” notes Naynish Kulkarni, Director—Mobility (South Asia and Middle East) at Frost & Sullivan. “As the Indian market is highly value-conscious, many OEMs offer free connected services for up to three years.” Convenience-orientated offerings such as voice recognition, navigation, remote engine start/stop, auto-lock/unlock, remote climate control, information regarding vehicle service and maintenance, roadside assistance, driving analysis, tyre pressure, battery status, fuel finder, valet alert and geo-fencing alert are all key features offered by automakers in India.

Services and features like these are rapidly becoming pivotal brand differentiators. “In the past, competition in the Indian automotive industry has revolved around sticker price, maintenance costs, fuel economy, and engine power,” says Kulkarni. “With the
increasing commoditisation of hardware and software-based services, the traditional norms of competition are changing.

That’s just one user, but their experience is not unique and there have been plenty of other teething problems in rolling out connectivity is required for maintenance functions as well as advanced features like assisted and autonomous driving. Cellular connectivity, particularly 5G, is thought to be the only wireless technology capable of providing the highly reliable bandwidth coverage needed for safe operations.” Many cities are keen to facilitate connected mobility via 5G technology, which should gain traction in the coming years but infrastructure rollout may be slower than anticipated.

Then there is the lack of regulation. “Like smartphones, these new technology-networked vehicles also need to consider regulatory issues related to privacy, data protection, encryption, and standardisation,” Kulkarni says. “Moreover, as the number of connected cars (and the vast amount of data they generate) grows, so will the cost and complexity of data collection and subscription management.”

Vehecmobile-to-everything

A number of industry watchers have voiced the opinion that intelligent vehicle-to-everything (V2X), vehicle-to-vehicle (V2V), and vehicle-to-infrastructure (V2I) technologies will play a key role in supporting various connectivity use-cases, such as adaptive routing and real-time navigation. “V2V and V2I technologies are at a nascent stage in India but the technology has great potential as it enables the city to exert control on traffic in numerous ways,” says Kulkarni.

Competitive parameters such as connected features and services, vehicle design, and internal user interface and experience are influencing the consumer outlook towards cars in India.”

Bumps in the road

The industry is clearly making moves towards a connected mobility ecosystem but plenty of hurdles lie in the way. One Indian resident told Automotive World: “In India we lack quality of service and network coverage. I drive a Honda car and subscribed to Honda Connect when it launched. When I met with an accident, the app was supposed to help connect the helpline but nobody answered the phone. I didn’t renew subscription after that.” Honda did not reply to requests for comment.

new features. “New complexities are always introduced by emerging technologies, which must be addressed. While the opportunity for connected vehicles appears to be exciting, multiple challenges such as slow network connectivity, a longer product development cycle, data security concerns, and a lack of frequency and bandwidth are preventing widespread adoption in India,” says Saha.

One of the biggest challenges on this front is maintaining consistent and dependable internet connectivity. Kulkarni describes the current infrastructure in terms of network connectivity as “a game spoiler.” As Saha points out, “The smallest lapse in service can mean the difference between safe navigation and an accident. Reliable and high-bandwidth connectivity is required for maintenance functions as well as advanced features like assisted and autonomous driving. Cellular connectivity, particularly 5G, is thought to be the only wireless technology capable of providing the highly reliable bandwidth coverage needed for safe operations.” Many cities are keen to facilitate connected mobility via 5G technology, which should gain traction in the coming years but infrastructure rollout may be slower than anticipated.

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Vehicle-to-everything

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India is taking a unique position in developing the next big frontier for connected cars
The Ahmedabad Municipal Corporation, supported by the Ministry of Internal Affairs and Communications in Japan, conducted an experiment in India to showcase how a V2X system could be used to enable a public transportation vehicle priority system. Leveraging V2X communication technology, the pilot explored the tracking of public transport vehicles and subsequent alerts to traffic management systems, cutting both travel time and vehicle emissions.

“There is growing awareness of V2V and V2I among the Indian government and automotive industry,” says Saha. “For larger corporates, feeding data in real-time directly into enterprise networks along with interconnectivity of their nationwide vehicular assets is proving to be a powerful efficiency and productivity tool.”

He pinpoints Lumax Auto Technologies as a company to watch in this space. In March 2020, Lumax announced a joint venture with Japanese firm Yokowo to manufacture and supply on-board antennas and other vehicle communication products to the Indian automotive industry. The company is also considering development of self-driving systems, V2X/V2V, and advanced driver assistance systems. Similarly, watch out for advances from Pricol Limited. In February the Indian automotive tech firm announced a strategic collaboration with California-based connectivity platform provider Sibros Technologies to offer deep connected vehicle solutions in the ASEAN and Indian markets.

**Outlook**

While specific forecasts vary, the general expectation is that the country’s connected car market will grow by over 20% between 2022 and 2030 as the availability of connected services diversifies. Audoin anticipates “exponential” growth in demand for connected services moving forward. Mayank Sikaria, President and Co-Founder of Sibros, is similarly bullish in his outlook. “With growing interest of OEMs to introduce advanced automotive technology particularly in India, it is projected that the country is set to witness to more than 300 million connected vehicles on the road by 2030,” he tells Automotive World.

F&S’s Kulkarni believes that connected technology will become the new norm in the next few years, improving safety as it does. With 5G connectivity he anticipates improvements in the technology, as “connected vehicles will be even smarter and smoother to use.” He also expects to see the industry move from tethered services with limited connectivity to next-generation connected services with embedded connectivity.

“After 2025, automakers will primarily focus on safety and cloud-based services,” Kulkarni predicts. “Future hardware processing will be done on the cloud and over-the-air updates will enable many new features directly on vehicle dashboard. OEMs will use cloud platforms for data assimilation and storage to capture the necessary vehicle data and derive value from connected and monetisation services.”
Automotive is at a powertrain engineering crossroads

Will Girling investigates the new emphasis on battery tech, emerging skill gaps in the EV market, and why it may be too early to abandon ICEs entirely
At the launch event for MAHLE Powertrain’s Vehicle and Battery Development Centres, Simon Reader, Director of Engineering Services, showed a graph from 2010 predicting the sales share of internal combustion engines (ICEs) versus electric vehicles (EVs). It forecast that EVs—including hybrid and battery-powered—would gain a modest 20% of the European market by 2030, while ICEs would continue to dominate. Now, in a 2022 reappraisal, he believes EVs are more likely to take 80%.

Asked by Automotive World whether the rapidity of electrification has taken the automotive sector by surprise, Reader states, “I’d say that’s a fair assessment.” Indeed, with the EU and US setting 2035 deadlines for the final production of new ICE vehicles, and the UK setting its own five years earlier, one could be forgiven for concluding that BEV dominance is all but assured.

However, MAHLE Powertrain believes it is essential to maintain a dual strategy that recognises the enduring relevance of both in a legislatively varied world. Furthermore, by remaining “tech agnostic”, the company believes it can strengthen and transform existing worker skillsets—understanding where the technologies vary, but also, crucially, where they are the same.

Focus on batteries

According to the International Energy Agency (IEA), there were 370 EV models on the market in 2020—a 40% increase on 2019. This is substantial growth, but, when one considers that global stock of light EVs rose from two million in 2016 to over ten million in 2020, it is hardly surprising. MAHLE Powertrain is acutely aware that EV uptake has been exponential and has subsequently invested over US$12m in new facilities to meet the needs of its clients.

“Batteries offer the most value,” says Mike Bassett, Head of Engineering. “Each component must be tested to ensure performance is properly optimised.” The company’s new Battery Development Centre is indicative of this focus—it can test performance, size constraints, safety requirements, battery pack design, and more. This in-depth research will be crucial as issues and limitations particular to electric motors become more apparent. One such problem is the tendency for batteries to deteriorate unequally despite being driven under similar conditions. A reason for this, it transpires, is because of different charging conditions—home and public charging infrastructure are far from homogenous, and some customers are unaware that fully charging lithium-ion can age the battery faster.

The relatively small pool of long-term data currently available for EV
batteries makes testing both exploratory and highly valuable. However, this also entails intense research to lay a foundation for future comparison. If an OEM wants to know the effect of one year’s worth of driving on a battery, MAHLE Powertrain must recreate variations of temperature and humidity over 12 months to gather that data. “Simulation would be preferable because it’s cheaper,” says Reader, “but we need to gather all the data on-site first.”

**Fuel: carbon neutral or carbon free?**

MAHLE Powertrain’s new Vehicle Development Centre—the only facility of its kind in the UK—demonstrates its agnostic approach to the automotive industry’s future. Capable of testing both EVs and standard gasoline-powered ICEs, it also shows significant investment in both hydrogen ICE and fuel cell testing. “Hydrogen ICE is actually a greater challenge than gasoline ICE; it’s much more dangerous,” says Reader. This is because the fuel produces nitrogen oxide during combustion, a respiratory system irritant, although no carbon is emitted. Catalytic reducers, such as those found on current diesel vehicles, can help to minimalise this.

As a fuel, hydrogen is currently showing its greatest potential in fuel cell electric vehicles (FCEVs), particularly road freight. Hydrogen ICEs currently have an average energy efficiency of 20-25%—comparable to gasoline—while FCEVs display a far
superior 40-60%. Using hydrogen in ICEs is, perhaps, just an example of the industry hedging its bets at an unknown time.

At this early stage, the use of hydrogen must still undergo a period of development. However, Reader questions whether the automotive industry’s true focus should be for carbon neutral fuel, not necessarily carbon free. Regulations for 2035 onwards currently suggest that new vehicles shouldn’t produce emissions at all, hence the sudden investment in BEVs. “But, if the emphasis was placed on carbon neutrality instead of ‘no emissions’, that would broaden industry response while still meeting environmental targets,” he suggests.

**Addressing the skill gap**

An emerging consequence of electrification’s unprecedented rise globally has been a noticeable expertise gap in key sectors. In 2021, Reuters reported that 3,000 graduate-level R&D positions in South Korea’s EV battery market were unfilled. If the country—whose industry currently supplies leading OEMs like Tesla, Volkswagen, and Ford—cannot keep pace, the development of EVs risks stagnation.

Focusing on the UK market, the Institute of the Motor Industry (IMI) recorded an 85% drop in EV-focused engineering certificates between 2019 and 2020. At current rates, it estimates that technician demand could outstrip supply by 2027. MAHLE Powertrain, Reader notes, will not be immune to a similar dearth in expertise if proactive action is not taken.

The value of people has never been more apparent, and the company has been partnering with universities to build a skill market suitable for sustaining the shift away from ICE. In addition, engineers with a mechanical background can be retrained and integrated into an EV-focused environment. “Aside from some aspects of software, they already have the practical skills necessary,” states Reader. Indeed, aspects such as electric auxiliaries, thermal management, power electronics and transmissions are shared by both ICEs and EVs. The result of blending these skills could be beneficial for engineers: “Workforces can become more flexible across departments, which is highly valuable for innovation.”

“From an industrial perspective, keeping an open mind will be key for developing solutions. The automotive sector is changing—in some respects faster than engineers themselves can keep up with. Despite the hard-line political stance being taken regarding ICEs by governments around the world, it seems clear that, from an industrial perspective, keeping an open mind will be key for developing solutions.”
The AUTOSAR partnership brings together leading companies across the automotive and software industry to develop and establish the standardised software framework and open E/E system architecture for intelligent mobility. It’s an exciting prospect, promising to establish global standards for future mobility. And with more than 30 partners across the globe, its potential to bring some much-needed standardisation is vast.

For me, however, the partnership’s greatest potential is rooted in safety, which it identifies as one of its core pillars. Safety still poses the biggest questions surrounding autonomous vehicles (AVs) as we consider how we can move from continuous small-scale trials to broadscale commercial deployments. How can we ensure vehicles are truly safe? How do we even define ‘safe’? It’s not enough to be able to demonstrate that an AV can safely travel in a predetermined route from A to B. To truly realise autonomous transport we need to know that AVs will be able to handle anything that the roads and highways can throw at them, that they will be able to recognise and appropriately handle the one-in-a-million chance incidents and accidents.

Today, that’s not how AVs are being developed. They are built for common scenarios that crop up time and time again in accident reports such as rear-end collisions. But as any driver knows, it’s the edge cases we encounter and the reactions of other road users to these unexpected scenarios that really test our driving. The trampoline blown onto the motorway in the middle of a storm, the child that follows a bouncing ball into the road or the duck that decides to cross the dual carriageway with her ducklings. These scenarios—and the countless others we can’t even envisage and may not have even happened yet—are what AVs need to be trained to manage. To do that from a development perspective is complex: how do you identify the scenarios to test and train? How do you avoid overtraining whereby achieving a safe response to one scenario makes the vehicle demonstrably worse in another?

These challenges can be overcome by adopting an edge case-first approach to testing which looks at the full spectrum...
of risk. It might seem sensible to start with tackling the easier scenarios first, but to cope with the true complexity of the real world the reverse is actually true. And it’s not just training—or retraining—AVs to cope with these scenarios that is challenging. One of the greatest hurdles to overcome is that today there are no singularly accepted standards or protocols by which AV developers can prove to insurers, regulators and the public that their vehicles are safe.

The lack of a robust, set ‘test’ that demonstrates an AV is safe is not just a barrier to regulators and insurers but also to the industry; we need to find a way to reassure all stakeholders and users. By taking the lead and proactively evidencing safety, the industry can build confidence and demonstrate a commitment to this key issue.

This is where AUTOSAR can play a significant role. They have already coalesced a powerful group of OEMs and Tier 1 suppliers with a clear remit and ambition, including a focus on safety. By agreeing to establish a set of safety standards to which all partners adhere, and promoting this as an example of best practice for AV developers outside the partnership, we can materially advance the safety of AVs, and the rate at which we are likely to see full-scale commercial deployments on the roads. The partnership model also allows for distributed development and sharing amongst partners, bringing further benefits when it comes to doing the heavy lifting of ensuring AVs can meet edge-cased focused safety standards.

It’s easy to assume that because AVs have been demonstrated to be broadly safe, that we’ve done enough. But this is a complex and nuanced topic, and until we know AVs can handle the complexity of edge cases, we won’t be able to capitalise upon the promises of this amazing technology. The industry has an opportunity to lead the charge here. AUTOSAR can drive that charge with a firm commitment to testing for edge cases.

About the author: Rav Babbra is Head of Business Development at drisk.ai and partner in the co-innovation project D-RISK, with Imperial College London, DG Cities and Claytex
Does Canada have what it takes to become a global EV innovation hub?

Tony LaMantia argues the case in favour of turning Canada into an EV mobility hub

The news that Stellantis and LG Energy Solutions are partnering on a Canadian electric vehicle (EV) battery manufacturing facility was transformative for the automotive industry in Canada. It’s a CA$5bn (US$4.1bn) investment—the biggest single automotive investment in Canadian history. It will have an annual production capacity of 45 gigawatt hours and will create 2,500 jobs. It’s a pillar for the foundation of Canada’s EV ecosystem, but it’s just the tip of the iceberg.

The Stellantis/LG investment is the latest in a series of announcements that ensure the Canadian automotive corridor will continue to thrive, while highlighting significant opportunities for American companies that can support Canada’s focused shift to building an EV supply chain.

Canadian EV investments in a nutshell

Let’s start with the automotive manufacturers. First, the most award-winning automotive manufacturing plant in North America—Toyota’s Cambridge facility, located near Windsor, Ontario, across the bridge from Detroit, Michigan—made a CA$1.4bn investment that paved the way for production of hybrid versions of the Toyota RAV4, as well as the Lexus RX hybrid and Lexus NX hybrid.
In late-2020, Ford announced a US$1.8bn investment to build five new battery EVs in Canada. Shortly after, Fiat Chrysler announced a US$1.5bn investment to build EVs that will likely use the batteries manufactured through the Stellantis/LG plant. Finally, GM has invested US$1bn to transform one of its existing plants into a hub for producing electric commercial delivery vans and another US$400m for a battery plant. In each case, federal and provincial governments have stepped up to support these investments.

That’s all of the Big Three plus Toyota making massive investments in the last few years.

It doesn’t begin and end with batteries, though. North America has a shortage of the materials for manufacturing batteries—nickel, cobalt, lithium—and the government has committed CA$3.8bn to fund the development of the country’s critical minerals industry. Only hours from Toronto and Waterloo is a massive untapped reserve of battery-making minerals in Northern Ontario.

CAMI Assembly in Ingersoll will be Canada’s first full-scale EV manufacturing plant when it begins production of BrightDrop fully electric delivery vans in Q4 2022.

All of the Big Three plus Toyota have made significant investments in EV production in Canada over the last few years.
A compact automotive ecosystem

Notably, the vast majority of this new investment is happening within a 250-mile-long corridor. The main Canadian manufacturing cluster is quite a bit larger—stretching from the base of Ontario into Quebec—but the most productive automotive corridor runs from Windsor, Ontario, to Oshawa, Ontario, a trip that takes about 3.5 hours on the 401 superhighway that connects them.

As the map below indicates, the manufacturing and automotive corridors overlap, and inside both of them is the Toronto-Waterloo Corridor, which is North America’s second largest tech cluster. There is no other location in North America—and few locations in the world—where a major automotive manufacturing ecosystem contains a major technology ecosystem.

For obvious reasons, this has led to a substantial amount of investment in new automotive technologies. Waterloo has more than 80 autotech companies—including Geotab, ESCRYPT, OTTO Motors—working on everything from EV analytics and automotive security to battery recycling. Waterloo is right in the middle of each of the concentric circles on the map. This mid-sized community of 600,000 is home to those autotech companies and North America’s most award-winning automotive manufacturing facility—Toyota’s Cambridge facility has won 16 J.D. Power Awards. It is also within an hour drive of major Honda, Ford and General Motors manufacturing facilities. Everything is very close together, accessible for suppliers and tech innovators alike.

An opportunity for global automotive suppliers and innovators

What all this signals is that the Canadian automotive corridor is exceptionally receptive to new EV and mobility investments, whether they are from Canadian companies, American companies or those that are further afield. Canada is committed to growing its EV supply chain—fast—and the governments are proving to be very willing investment partners. There are also gaps—in mineral mining, refining and most importantly, processing, battery component manufacturing, refurbishing and recycling and EV components—that means opportunity for OEMs and suppliers looking to grow.

And not just grow in Canada, either. The US-Mexico-Canada Agreement (USMCA) means that most components produced here won’t face tariffs at the US-Canada border. This makes the Michigan automotive cluster a prime potential customer. It’s only a few hours drive from Toronto and just across a river from Windsor. Other locations that have major automotive manufacturing clusters—Kentucky, Tennessee, Indiana—are all within a less than a day’s drive.
And it’s not just the US, either. For developers of products with a global market, Canada has the world’s most comprehensive trade network, including agreements with the European Union, Japan and the UK.

Canada is also fertile ground for companies that are looking to invest in research and development. The tax credit and grant programmes are very generous and there is an excellent reservoir of automotive talent. The University of Waterloo, for example, located in the middle of Canada’s automotive corridor, is home to Canada’s largest collection of automotive researchers and has deep experience helping manufacturers and suppliers develop new products to climb the value chain. It is so close to America’s automotive hotbeds that the transfer of information and expertise is seamless.

The global transition to EVs is a once-in-a-generation happening, and for companies looking to grow, Canada has the best deal on the table.

About the author: Tony LaMantia is President and Chief Executive of the Waterloo EDC
Kevin Czinger’s clean sheet approach to design and assembly creates a fundamental circular economy manufacturing system. Megan Lampinen investigates
Designing and producing a vehicle today is both asset-and capital-intensive. The late Sergio Marchionne was a vocal critic of the automotive industry’s insatiable appetite for capital, epitomised in his ‘confessions of a capital junkie’ pitch to investors. While Marchionne believed the key lay in consolidation, there could be another solution.

What if someone could essentially take out the engineering and assembly cost involved in building a new vehicle? And what if that assembly setup was also toolless? Kevin Czinger, Chief Executive of US start-ups Divergent Technology and Czinger Vehicles, has done just that.

Czinger, who knew Marchionne for over a decade, shares the latter’s capital concerns. One of Czinger’s early projects involved building a car factory in China, during which time he realised the tooling and fixturing demanded more capital outlay than all of the technology development. He was also concerned about the factory’s CO2 emissions. With EVs, the key metric here is kilograms of CO2 emitted per kilowatt hour (kWh) of battery cell manufactured. The majority of the Chinese battery manufacturing facilities use low cost coal powered electricity generation. These coal powered battery manufacturing facilities generate around 200-250kg of CO2 per kWh of battery manufactured. For a 90kWh battery that would mean 18,000kg of CO2 emitted in the battery system manufacture. In comparison, a Toyota Camry with an average 120g/km CO2 emissions generates about 15,36 kg of CO2 from tailpipe exhaust after being driven for 80,000 miles.

Seven years ago, Czinger founded the two companies mentioned above: Divergent Technologies to create a set of digital design and assembly tools and Czinger Vehicles to showcase a product made from those tools. “This marks a move from the manufacturing equivalent of the printing press to desktop publishing,” he asserts.

The Divergent Adaptive Production System

The Divergent Adaptive Production System (DAPS) brings together generative design, 3D printing and fixture-less V-cell assembly to radically redefine automotive development and production. The process kicks off with the designer describing to the software the problem that needs to be solved. The software then suggests a solution optimised for various engineering, manufacturing and assembly constraints. That design is then 3D printed using a printer purpose-built for the application. Czinger claims it can print at a rate that is 15 times faster than what is commercially available today. “They’ve never seen anything like this before,” he emphasises.
Then it’s time for assembly. “The generative design and printing produce the perfect Lego blocks,” Czinger tells Automotive World. “They need to be assembled in a universal assembly machine. The blocks come up and the machine recognises they are for a specific model drone or electric vehicle (EV), and it starts to assemble. It doesn’t care what you’re printing. It’s sending data—SUV data or drone data—that goes into the machine and out comes a fully optimised, fully assembled structure.”

Ultimately, this system is designed to create a fundamental circular economy manufacturing system. It optimises the structure and removes excess material, energy and capital needs. This greener approach to design and production is all the more pivotal with the industry’s shift to electrification and the spotlight on CO2 footprint.

“With EVs people think, the car has no tailpipe emissions so you can consume as much material and energy as you want and it doesn’t matter,” says Czinger. “We have to stop fooling ourselves if we’re ever going to get serious. It doesn’t matter to the planet whether the emissions are in one place or another. You use coal-fired power to build a Tesla battery in Tianjin, so even if in California there’s no tailpipe exhaust we still suffer from global warming.”

Lifecycle assessment has been applied to the industry for decades. When Czinger first started to analyse manufacturing emissions he used the Argonne National Laboratories Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model, which covers extractive, processing and manufacturing CO2 emissions. “This looks at everything, such as the infrastructure that has to fuel it and end of life. Is the vehicle simply thrown away or is it reused or recycled?”

**A disruptive transition**

The combination of sustainability benefits and capital savings could be significant. In theory, this approach could remove most of the capital barriers to entry and the creation of products, dramatically opening up the market to newcomers. “Over ten years this will really
shake things up,” predicts Czinger. “The cat is out of the bag.”

Today, Divergent Technologies has 18 programmes in place with various customers, including five of the top 10 largest automakers. The first programme will go to market in the third quarter of 2022. Names are being kept quiet for now, but it’s likely that many industry incumbents will find this clean-slate approach a difficult transition. After all, some have spent a century building up their legacy production footprint.

“There is a transition when you use this system,” concedes Czinger. “It is the very first system to replace existing structures [for parts like] frames and suspension systems. What I tell these players is to do this now and learn the system. Position it so that there’s no reason why you can’t. Because of the industry move to EVs and other new regulations, this is a time when auto companies—for the first time in 100 years—are probably willing to take some risks.”

He also recommends a gradual approach, starting with using this system for a specific structure. “Mitigate risk by replacing an existing structure it. Then start to design whole parts of the car digitally with that specific architecture.” The risk of not acting now, he warns, could be existential.

As with any disruptive technology, there will be critics. “A critic would say, let’s see it happen. Show me the proof,” Czinger says. That’s partly where the Czinger 21C comes into play. Czinger Vehicles is using Divergent to manufacturing this demonstrator vehicle, a hybrid sports car with a limited production run of just 80 units. The 21C should launch in 2023 and is intended as the first in a series of ultra-performance vehicles.

The factory of the future

As the creative force behind Divergent Technologies and Czinger Vehicles, Czinger is understandably bullish in his outlook for the system. But he’s managed to convince others as well. David Beirne, a General Partner at venture capital firm Benchmark Capital and a Divergent board member, described the DAPS system’s long-term potential as “revolutionary across multiple industries, not just automotive.” Marchionne was also apparently a supporter. “He dug my ideas,” says Czinger. “He is not here to disagree but the future will tell how much he dug them.”

But does this represent the factory of the future? “I believe so,” he tells Automotive World. “If we’re going to survive we need to take all the processing power available and use it to look at all the manufacturing factors and radically reduce the material and energy flows.”

DAPS is all about simplifying the complex. Its offering of a complete modular digital factory for complex structures—when done correctly—could address pivotal pain points in today’s approaches. “Imagine a localised factory that is adapting, so it never goes away but is instead a permanent manufacturing footprint,” he says. “On top of that, the materials that it uses are localised and flow in a localised flow. Those are the principles that a factory of the future should have.”
The fortunes of the global motorcycle market have been undulant in recent years. Having suffered stagnating sales between 2014 and 2020, and the COVID-19 pandemic undermining growth for 2021/22, the industry’s direction has been uncertain for some time. However, that could all be about to change.

A forecast from analyst Fortune Business Insights predicts that global motorcycle sales will grow from US$127.4bn in 2022 to US$223.5bn in 2029, a compound annual growth rate (CAGR) of 8.4%. Meanwhile, market database Statista estimates a comparable growth in electric motorcycles (e-motorcycles) across the same period—US$17.25bn to US$28.16bn, a CAGR of 7.4%.

With bans on the sale of internal combustion engines (ICEs) vehicles set to come into effect across several regions by the 2030s, it seems apparent that electrification will only become more relevant to the sector. Dr Robert Hentschel, Chief Executive of Norton Motorcycles, gives Automotive World a first-hand account of a legacy OEM making its transition into the age of electric transport.

**Going beyond ICE**

“The world is electrifying,” states Hentschel. “It is incredibly important to have a plan in place besides ICE; we must all look ahead.” Indeed, demand for

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Norton: motorcycles must be reinvented for the electric frontier

Will Girling speaks with Norton Motorcycles’ Chief Executive about two-wheeled transport’s transition from ICE to EV
both e-motorcycles and electric mobility solutions generally have taken on international significance as the age of ICEs gradually tapers off.

A Euro-5 compliant ICE motorcycle emits 25% less CO2 than a Class 6 diesel car and 31% less than a gasoline car. However, although apparently cognisant of two-wheel vehicles’ greater fuel economy and cleaner performance, the UK government is still set to ban the sale of new gasoline motorcycles by 2035—five years after its scheduled ban on new ICE cars and vans. This commitment matches the US’ and EU’s proposed blanket bans on all new ICE vehicles by 2035, although the US market’s exact position on motorcycles is unclear.

On the other hand, Hentschel believes there is another reason that goes beyond the environmental debate: innovation. With their innate manoeuvrability and small size that makes them ideal for urban spaces, e-motorcycles could be an integral part of tackling ongoing issues like congestion and a lack of parking spaces in developing cities. To go truly beyond ICE, the sector must harness and capitalise on these strengths.

**The electric frontier**

Although the powertrain of an e-motorcycle will be much simpler than ICE, there are still challenges to overcome. Aside from balancing range and performance, two-wheel vehicles must also factor in battery weight and size to ensure the finished product is comfortable and safe for the rider. Furthermore, the feasibility of scaling e-motorcycles, like all EVs, will be predicated on the concurrent development of charging infrastructure. Despite this, Hentschel is confident that Norton can position itself as a “leader on this electric
“frontier” and “design a world-class electric motorcycle that marries beauty with performance.”

For now at least, motorcycle OEMs have some breathing space to explore before transitioning to electric vehicles (EVs), although some, like Harley-Davidson, have become early adopters—the company released its electric LiveWire model in 2019. However, a report by motorcycle insurance specialist Bennetts found that customers still express two main points of hesitation regarding e-motorcycles: an aesthetic preference for the sound of an engine and range anxiety.

Regarding sound, some OEMs are already creating solutions. Yamaha announced in August 2021 that it was developing simulated exhaust sounds for its EVs—the company claims that sound is a crucial form of sensory feedback for riders to have a sense of speed and control. Range anxiety, however, remains a more stubborn challenge. The Livewire has a spec between 95 and 146 miles depending on use, while Damon’s 2021 HyperSport Premier is reported to exceed 200 miles. However, priced at US$40,000 compared to US$22,000 for the LiveWire, consumers seeking to shift to EVs will be forced to consider if the greater range of Damon’s offering is worth double the upfront cost.

Adjusting production

In June 2022, Norton announced that it had received funding from the UK government’s Advanced Propulsion Centre (APC) 19 for a 30-month project. In effect, this has kickstarted the company’s development of an all-electric motorcycle and—most crucially—expand its engineering capabilities.

Called ‘Project Zero Emission Norton’, Hentschel is enthusiastic about Norton’s potential to develop a world-class entry for the e-motorcycle market. Nevertheless, he is also aware of an impending expertise shortage as EV production ramps up globally. “There is a recognised skills shortage in the UK. One element of continuing...
One element of continuing this journey is training our people: transforming their mechanical background into an electrical and mechatronic one.” This problem is far from exclusive to the UK.

An investigation by Reuters found that the South Korean EV battery industry, which supplies automotive leaders like Tesla and Ford, has over 3,000 unfilled degree-level positions in R&D. Meanwhile, the EU industry is estimated to require an additional 800,000 workers by 2025 to meet demand. Likely exacerbated by the ICE to EV transition, which is changing supply chains and obscuring investment points, this problem will need urgent attention if growing customer demand is to be met.

**Motorcycles: part of mobility’s future**

Global ownership demographics could be the most significant factor in the motorcycle industry’s future. A survey by US think tank Pew Research Centre found that distributed ownership of vehicles powered by two wheels (PTWs) ranked highest in Thailand, Vietnam, Indonesia, and Malaysia—all over 80%—while car ownership was generally rare. Conversely, countries with low PTW rates—the US, UK, and Germany all scored lower than 20%—had much higher car ownership. Therefore, motorcycles seem to hold stronger appeal among demographics that cannot afford or access a car. Appealing to and meeting the needs of these markets in the context of electrification will be essential.

Ultimately, ambition will likely pay dividends in an industry that is coming to terms with a new identity. In April 2022, TVS Motor Company—which acquired Norton in 2020—apparently recognised this by announcing US$120m of new investment. The funds, according to Joint Managing Director Sudarshan Venu, will support Norton on its journey “towards electrification, cutting-edge technology, world-class vehicles, manufacturing, sustainability and the future of mobility.” Indeed, Norton’s example should be instructive for the industry: when others don’t know what to say, the ability to reshape the conversation is invaluable.
Vehicles of the future could be developed like smartphones

Will Girling consults experts from Oracle and Deloitte on how digital twin technology is unlocking a transformational new manufacturing paradigm
As the automotive industry gradually shifts towards a course of electrification, one notable consequence has been the increasing technological complexity of cars themselves. Statistics portal Statista’s forecast that the global automotive semiconductor market will be worth US$116bn by 2030—up from US$39bn in 2020—is testament to this trend.

“The automotive industry has completely changed,” Aniello Pepe, Global Director of Automotive at Oracle, tells Automotive World. As the provider of an IoT-based digital twin solution used by automakers and their suppliers, software provider Oracle has observed a seismic shift in manufacturing standards: “It’s becoming practically a new industry.” Pepe identifies three trends as the cause for this transformation: the shift from internal combustion engines (ICEs) to electric vehicles (EVs); automakers branching out and selling services in addition to vehicles; and vehicle integration with software.

“Interestingly, when we consider manufacturing, all three of these trends are related to the adoption of digital twin,” he continues. Capable of generating a virtual representation of an object, system, or process, digital twin represents an opportunity to improve factory processes, create a proactive industry mentality, and unlock value in a new technological era.
A new manufacturing mentality

Debanjan Dutt (DD), Global Automotive Supply Chain leader at Deloitte, believes the term ‘digital twin’ is frequently misunderstood and misused within automotive: “It means many things to many people.” Far from being a monolithic technology, digital twins comprise several interconnected aspects that combine to generate value.

From smart manufacturing to asset management and simulated supply chains, all these processes have their own digital twin model, which in turn has its own lifecycle. Subsequently, the ‘digital thread’, which manages and connects these separate aspects into a cohesive strategy, is causing a mentality and culture shift for manufacturing operations. “Instead of being at the receiving end of whatever the engineers develop, manufacturers can now have a voice at the beginning of the process,” adds Stavros Stefanis, Principal Supply Chain and Product Strategy at Deloitte.

The realisation of digital twin’s potential is now firmly taking root. Citing the increasing technological sophistication of its vehicle designs, Renault announced in June 2022 that it will be incorporating digital twin in its development process. The company called this a crucial step to cope with the industry’s “increasing number of technical and regulatory requirements,” as well as the need to constantly improve both current and future models.

The value of flexibility

Consulting firm AlixPartners stated at its 2022 Global Automotive Outlook conference that the worldwide supply of semiconductors might not meet demand until 2024. This is a worrying prospect for an industry increasingly investing in EVs and battery technology–AlixPartners forecasts an extra US$546bn between 2022 and 2026. As such, the ability for OEMs to simulate risks in their supply chain using digital twin and create what Pepe calls “zero-latency
supply chains” is also significant. “When an event is compromising your supply chain, you can use that data and react to it with a digital twin. You can evaluate the effect and then seek alternatives.”

While automakers might need to spend time and money compiling the large datasets across their operations, the results could prove worthwhile in the long term. In a July 2021 article for the Financial Times, Dong-Il Park, former Vice President of Hyundai, stated that initial investment costs were soon offset by the company’s newly acquired ability to “dramatically advance the production process” and experiment without needing to create a physical prototype.

Agility and flexibility are the direct rewards of adopting digital twin. As a result, Stefanis believes that automakers are moving away from annual product programmes and towards continuous, iterative development cycles: “It’s like smartphones—there is no ‘iPhone 2022’; there is an iPhone X, iPhone 11, etc.” In this new paradigm, core manufacturing programmes will focus on continuously enhancing products and processes while ineffective, inefficient, and undesirable elements are “versioned out.”

**Servitisation of manufacturing**

When it comes to the objectives that automakers prioritise, DD believes that cost, quality, and productivity are among those most highly valued. Productivity and quality can be met by utilising the agility and co-operation fostered by using digital twin, but what about cost-efficiency? Pepe identifies the servitisation of manufacturing processes using digital twin as an important method for unlocking value.

As automakers seek greater operational cost-efficiency, the utility of servitisation becomes apparent. In 2017, the Organisation for Economic Co-operation and Development (OECD) found that in-house
Digital twin can help manufacturers realise that their current machinery can be optimised to produce extra units, as opposed to spending money on new machinery.
realise that their current machinery can be optimised to produce extra units, as opposed to spending money on new machinery."

Furthermore, instead of relying on broad maintenance plans for their equipment, manufacturers can use actual usage data to unlock a “true maintenance plan” that restricts upkeep costs until they are genuinely needed.

**Creating an industrial playground**

While the breadth of insight generated by digital twin is already substantial, Stefanis thinks that the best is yet to come. If the technology can already create a simulated version of a manufacturing environment, he suggests that the next step would be to develop the actual experience: “By incorporating augmented reality (AR) and virtual reality (VR), you could create an immersive experience for customers and suppliers.” In this situation, vehicle parts could be virtually ‘reviewed’ and recommendations made to designers, which would then be checked against digital twin models and finally validated by the manufacturing team.

Ultimately, this advancement, which would not be possible without digital twins, will enable automakers to manage their business using encompassing simulation models instead of focusing on granular issues. Within this new ‘industrial playground’, DD adds that breaking down team silos will be crucial. “To improve the outcome and velocity of outcomes, you need integrated, cross-functional teams. Product development, purchasing, manufacturing, IT, and artificial intelligence teams—a team of five or ‘starfish’ model—must come together as an agile unit.”

Digital twin, therefore, is a facilitator for transforming a manufacturer’s ecosystem and strategy into a core market differentiator. “If executed correctly,” says Stefanis, “your assets become a platform for others to drive the next era of innovation.”

Volkswagen Automotive Industrial Cloud is a clear example of this in practice: a marketplace for the collective mobility ecosystem to build scalable solutions, with a focus on connected and autonomous vehicles. Although the current maturity of digital twin may vary between OEMs, the industry must learn that such exciting possibilities are science fact, not science fiction.
Asia is leading the gigafactory push: how can others keep up?

Sam Steers investigates Asia’s dominance of the gigafactory market and what other regions are doing to become less reliant on it as EV demand escalates

The ever-growing demand for electric vehicles (EVs)—which is expected to reach 40 million units by 2030, a date that coincides with the ban on internal combustion engine (ICE) vehicles in the UK—has prompted mass investment into gigafactories to accelerate EV and lithium battery production.

First coined in 2013 by Tesla Chief Executive Elon Musk as a way of describing a facility that he was building in Nevada, the term ‘gigafactory’ refers to a manufacturing plant that constructs EV batteries, with some also assembling full EVs. Asia dominates when it comes to these facilities and is expected to outperform other regions such as Europe and North America between 2022 and 2030. This is according to Fitch Solutions, which pegs Asia’s current capacity in 2022 at 1,240GWh. By comparison, Europe has 285GWh of capacity while North America has 208GWh.

“This means that Asia currently has 71.6% of the total global capacity,” says Phoebe O’Hara, Country Risk and Industry Research Associate Analyst at Fitch Solutions.
Asia’s dominance is down to the early establishment of several battery makers in the region, many of which have been in operation since the early 2000s and have been operating at scale for years. “The EV transition has been massively pushed in the region over a much longer time period,” added O’Hara. “The governments have been quick to provide EV incentives and subsidies, and that has driven R&D investment in the segment.”

OEMs will need to increase the locality of EV battery manufacturing

Cash injections into Asia and the gigafactory industry far surpass those in other regions such as the US and Europe. “In June 2022, for example, three Chinese battery companies...
managed to raise US$10bn by themselves to fund the expansions of their operations,” O’Hara said.

The EU’s US$2.6bn contribution to the battery industry was provided to only 12 countries, while the US contributed US$45m in funding to support local endeavours. The differentiation in market position between the US, Europe, and Asia continues to be seen in other areas of the industry, namely the upstreaming or mining segment.

“Many of the metals that go into EV batteries are produced and refined in China. As a result, China controls 80% of refining capacity for lithium, a metal found in the majority of EV batteries,” O’Hara explained.

This lack of investment and mining ability means that the EU and the US heavily depend on China to aid their EV operations, both for battery mining and EV production. Both regions are trying to build their own gigafactories to become more independent, but a lack of upstream capability means that their reliance on Asia—and therefore its market dominance—will remain for the foreseeable future.

Aside from upstreaming and investment, O’Hara pointed out that COVID has demonstrated the risks associated with heavy reliance on a particular region, specifically in relation to uncertainty surrounding supply chains. “Europe and America will want to reduce this vulnerability,” she said.

Domestic supply chains could help reduce reliance

Politics presents another barrier to gigafactory independence. In June 2022, the world’s largest lithium

Tesla’s gigafactory in Freemont, California, US
producer, Albemarle, advised the US government ‘to cut the red tape’ to accelerate the development of domestic supply chains and gigafactories, thereby reducing the country’s reliance on Asia for battery materials and gigafactory capacity.

This will enable automakers to have a local reliable supply of EV batteries, which will be essential if automakers are to remain competitive in the EV transition. “The industry has already seen what can happen when there are shortages of an essential car component, such as the semiconductor shortage, and what that creates in terms of disruption for manufacturers. To avoid that, OEMs will need to increase the locality of EV battery manufacturing,” highlighted O’Hara.

She suggested that Latin America (LATAM) is in a better situation than the competition, although it could be deemed a newcomer to the industry. While EV demand is currently low there, it has potential. Fitch Solutions had seen “huge exponential growth” in investments into Argentina over the last year for lithium mining and expects demand for EVs to increase strongly as soon as 2023, with most of the driving force coming from markets such as Brazil.

A report recently published by Fitch Solutions found that several incentives introduced by both Latin and Central America will aid the region’s market growth further. “For example, we forecast that EV sales in Latin America will increase by 41% in 2022, and we know from interacting with automakers that this is going to drive interest in localising the region’s battery manufacturing,” commented O’Hara.

Fitch Solutions predicts that once Latin America becomes an established player, it will be very competitive. It also believes that automakers may export some EVs assembled in North America to Latin America to be sold to potential buyers. “This will further increase LATAM’s productivity and competitiveness,” claimed O’Hara.

Until Latin America finds its feet, though, and the US and EU are able to onshore their supply chains, the gigafactory market situation remains the same with Asia very much in control.
Daimler Truck Innovation Center India: global software and ZEV hub

The global trucking giant chose Bengaluru as the location of its latest development centre for connected, zero-emission mobility. By Megan Lampinen

Daimler Truck is one of the largest commercial vehicle manufacturers in the world. Spun off from Daimler AG in 2021, it boasts 35 key locations across the globe, employing around 100,000 people. And a large chunk of its product engineering and IT expertise comes out of Bengaluru, India.

In March 2022 the trucking giant officially launched the Daimler Truck Innovation Center India (DTICI), a fully-owned incubator to create scalable innovations for the company’s global product portfolio. “We already had an engineering and IT centre here in Bengaluru for Daimler as a whole, but we took the trucks and bus portion and created a new entity, which is DTIC,” explains Raghavendra Vaidya, Managing Director and Chief Executive at DTICI.
The Bengaluru facility joins a network of Daimler Truck global R&D locations spread across North America, Japan and Germany. Developments at the centre will feed into all business units and brands: Mercedes-Benz, Freightliner, Western Star, Thomas Built Buses, Fuso, Bharat Benz and Setra.

“We are a start-up company with a long legacy and deep expertise,” Vaidya tells Automotive World. “Our teams have been working on engineering and IT for more than a decade under a different constellation. But in some ways we are also a start-up because the commercial vehicle business is very different today. Our strategy must adapt to be part of Daimler Truck’s new journey towards future mobility.”

Industry transformation

All truck makers today are scrambling to position for an increasingly connected and clean future. In many cases that demands the development of CO2-neutral drives and software-defined vehicles. Zero-emission vehicles (ZEVs) are a top priority at DTICI, and considerable focus will be directed towards electrification topics and powertrain engineering.

“For the past two or three decades we have focussed on the total cost of ownership, safety and regulations,” says Vaidya. “Going forward, much of our focus is on how we manage to become CO2 neutral, both in terms of the vehicles that we produce as well as our manufacturing operations.”
Daimler Truck’s recently released Sustainability Report commits to a CO2 neutral target by 2039.

Considerable investment has been poured into transitioning away from internal combustion engines that run on fossil fuels and towards either battery electric or fuel-cell electric vehicles. Daimler already offers a small number of all-electric trucks in the US and Europe, but as Vaidya concedes, “We’re still a long way away as an industry, as an ecosystem, from being close to CO2 neutral.

DTICI’s second focus area is on the use of software and connected trucks. For years Daimler’s trucks have been incorporating a growing amount of electronics and software to make them safer and more comfortable. But Vaidya sees a step change coming: “As we go to zero emission vehicles, the software becomes extremely important. That could be for predicting the range of a battery vehicle, which is a very complex exercise, or using the stored energy of batteries in an optimum way to either move the truck or heat or cool in. It could also be about continuously communicating with the truck through the connected technologies.”

**Home of next-gen telematics**

DTICI opened several months ago with the remit of addressing vehicle engineering, powertrain engineering, software development for electronic control units, computer aided engineering (CAE), computer aided design (CAD), and IT programming. It offers state-of-the-art software tools and labs to facilitate developments around connectivity, cyber security, Big Data, advanced analytics, system integration and electrification.

Notably, DTICI has overall responsibility for Daimler Trucks’ global next-generation telematic platforms. “The entire strategy for the telematics platform and its implementation—how we put it into the field, test it and make sure it runs—that is all driven from India,” emphasises Vaidya. “This is one of the few occasions where we have complete accountability—not just ownership but accountability—for a key domain within software and electronics. We’re doing that for the Common Telematics Platform and we are in the process of creating the next generations.” The pressure is on to get it right

“We have hardware-in-loop labs to test the software and electronics by simulating the truck in the lab,” Vaidya explains. For example, testing a telematics platform inside a truck is very expensive. It has to be integrated into the vehicle and road certifications must be obtained. At DTICI, the hardware-in-loop labs allow for simulation of a truck and various conditions—acceleration, braking,
safety protocols—to determine how the software and electronics behave. “We have a very advanced lab infrastructure and can simulate part of the truck or even the entire vehicle sometimes. That saves money and it also means we test more mature software by the time we install it into a physical truck for a test drive,” he points out.

A design team at the centre is tasked with developing best-in-class products to redefine the interior and exterior across Daimler Truck’s extensive range of vehicles. In the move towards future mobility, that could look very different from today. “The interior will start looking more sophisticated,” predicts Vaidya. “The instrument clusters in today’s trucks are not very nice compared to the clusters that you see in the cars, but we’re working on the next generation human machine interface, which is based on an Android device and has an advanced touchscreen. The interior is going through an overhaul.”

The evolution of the vehicle exterior is all about aerodynamics. Heavy-duty trucks haul considerable weight and if the aerodynamics is not right then the fuel efficiency will suffer, and customers won’t stand for that. “Much of what we do for the vehicle’s external development is around reducing the drag and improving the aerodynamics, along with optimising the coupling between the tractor and the trailer,” he notes.

**Why India?**

Zero emission vehicles and software-led innovation are big innovation areas for most truck makers, and India has plenty to offer as a development base. “Why India? Three reasons:

talent, talent and talent,” says Vaidya. “It is as simple as that.”

DTICI employs 1,300 skilled engineers on product engineering and IT. In this case product engineering ranges from mechanical engineering design to electrical engineering, with a heavy focus on electronics and software, with full-scale IT coverage. “There is no better place than India to build great engineering talent at scale,” he emphasises.

**We are a start-up company with a long legacy and deep expertise**

Vaidya claims that the second advantage factor for India is its ability to work with different geographies, which come with different cultural nuances. He believes India has perfected that cultural balancing act. “We are very flexible in how we can work with different cultures and understand the product,” he adds. “And we never stop pushing the boundary on what’s possible in India. When my colleagues in the US or Germany ask what’s possible in India, my answer is very simple: whatever we want. The rest is leadership challenge. That’s why we created the centre here.”