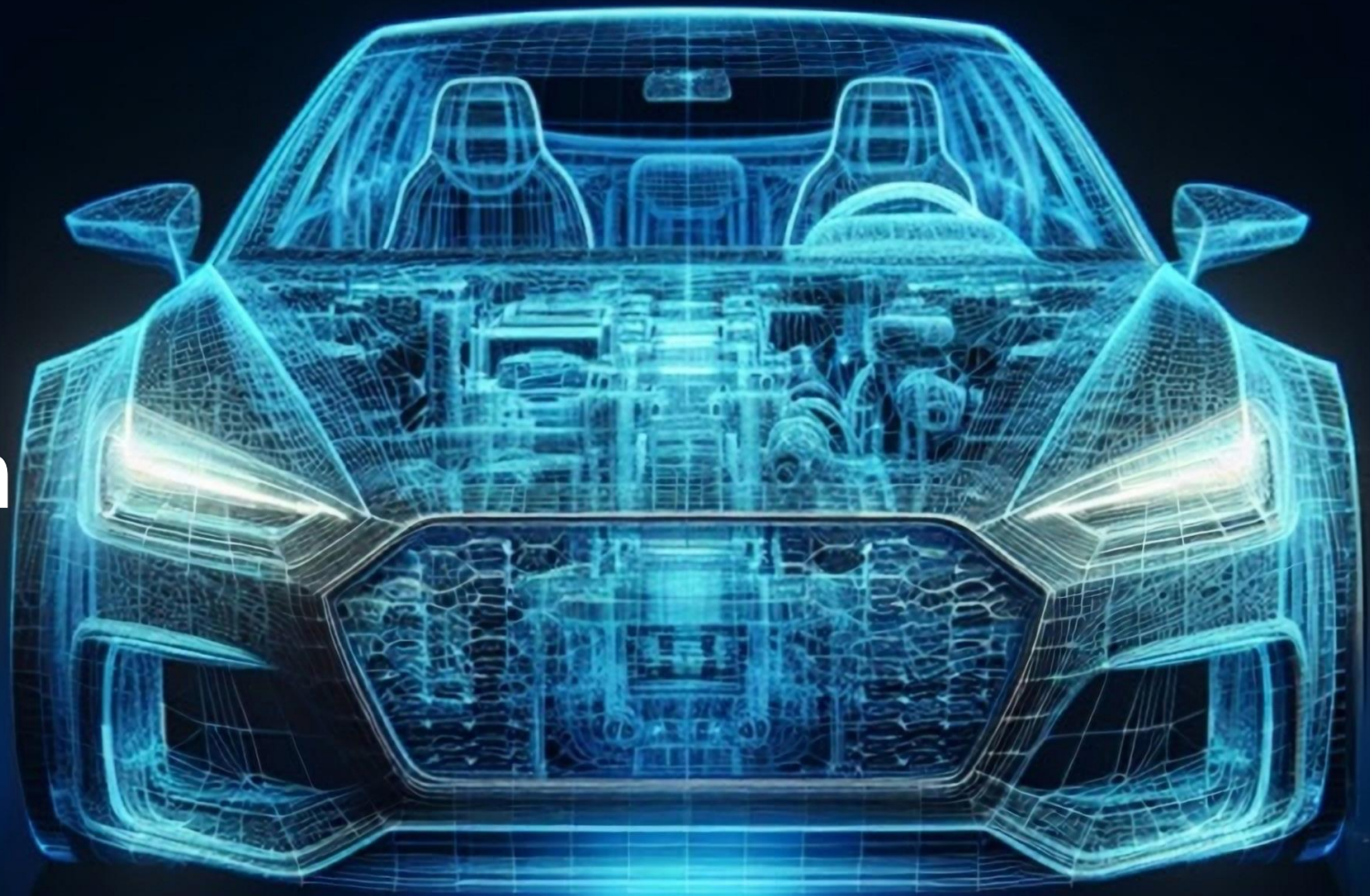
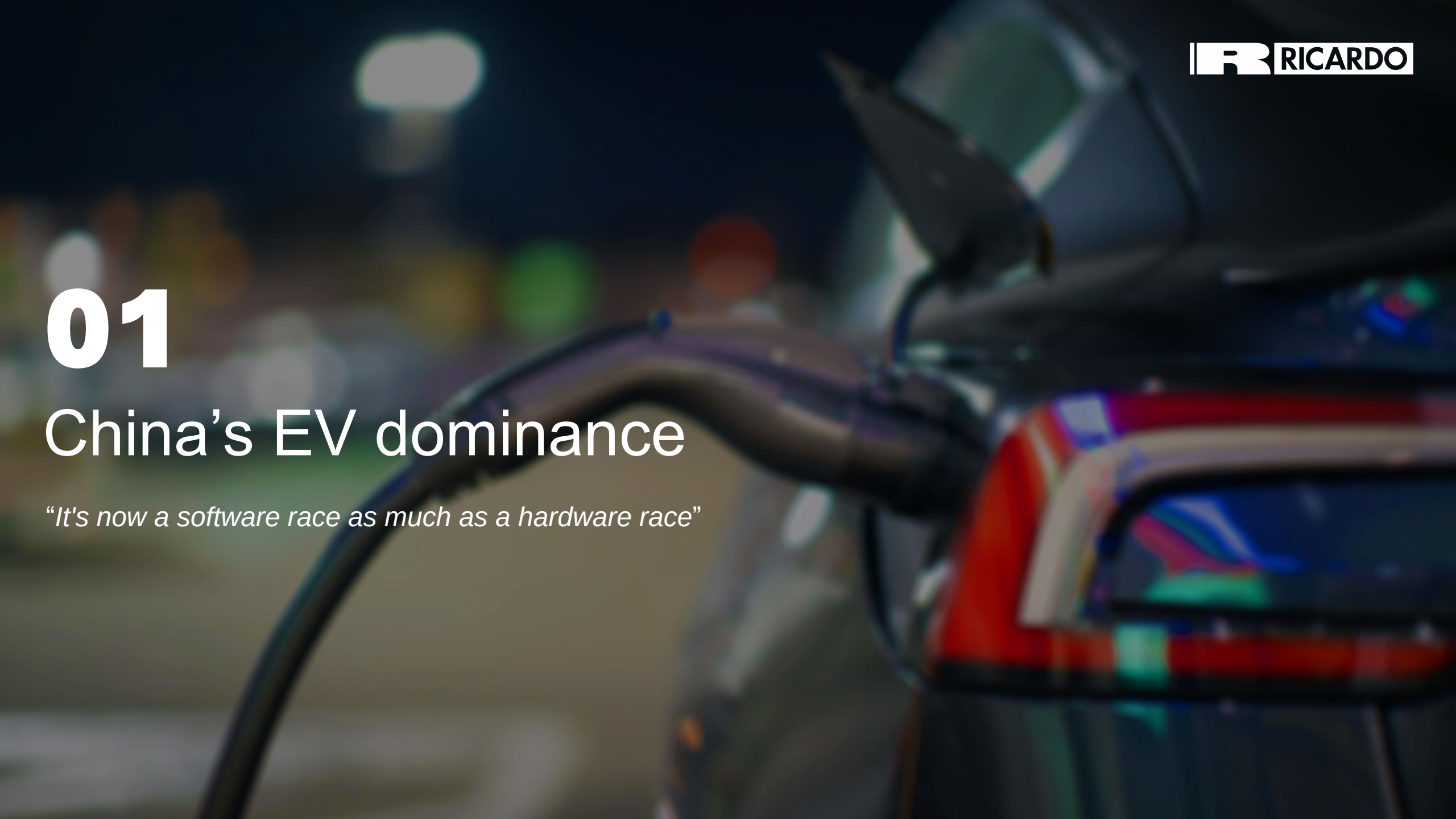
RICARDO

Next generation Vehicle Control Software





01

China’s EV dominance

“*It's now a software race as much as a hardware race*”

CHINA: THE GLOBAL EV LEADER

China’s dominance of the electric vehicle market is one of the most transformative industrial shifts of our time.

In the early 2000s, China made a bold decision to ‘leapfrog’ the internal combustion engine and direct all R&D towards the EV market, backed with significant government support.

The 2010s saw rapid acceleration and consolidation of technologies (see next page), leading to China’s current position as the global leader of EV, producing nearly 70% of all EVs globally last year.

THE RISE OF THE EV ERA IN CHINA, 2000-2025

Foundations & Government Vision (2000–2010)

- **“863 EV Project”** (2001) and Auto Industry Policy (2004) initiated national R&D [1]
- **Major public subsidies** began in 2007; NEV city pilots in 2009 [1,2]
- **Strategic leapfrog**: focus on EVs to bypass global ICE leaders

Industrial Boom & Supply Chain Dominance (2010–2020)

- Over **$230bn** invested in NEV development [3]
- China becomes global battery hub: **75% of global lithium-ion** cells by 2022 [4]
- Tesla Shanghai Gigafactory (2019) boosts **domestic competition** and **tech transfer** [3]

Mass Adoption & Global Expansion (2020–2025)

- EV market share: ~6% in 2020 → **~48% in 2024** [1]
- BYD becomes top EV seller (4.3m in 2024), surpassing Tesla [5]
- China produced 70% of global EVs in 2024; domestic brands = 80% of sales [3]

Strategic Impacts & Global Tension

- EVs reduce oil dependence; **>50%** of new cars in 2024 were EV/Hybrid [2]
- **Tech spillover**: AI, robotics, semiconductors, autonomous driving [3]
- **Trade pushback**: US & EU tariffs, WTO cases reflect China’s industrial strength [1]

References:
- [1] “History of electric vehicle industry in China”, Wikipedia
- [2] “Plug-in electric vehicles in China”, Wikipedia
- [3] “The Shift East: How China’s EV Boom Powers Its Tech Rise”, Time
- [4] “Automotive industry in China”, Wikipedia
- [5] “How China Curbed Its Oil Addiction and Blunted a U.S. Pressure point”, WSJ
- [6] “How BYD caught up with Tesla in the global EV race”, Financial Times

Q&A

Are you seeing consistent approaches to robustness and safety in Chinese EVs?

Safety is a serious concern for Chinese OEMs, especially as they expand towards foreign markets like Europe and the US.

Over the last few years, we have seen a clear evolution towards globally-recognised safety frameworks like ISO 26262 and sometimes for vehicles produced solely for the local Chinese market.

However, we see a different risk appetite. Compared to more traditional OEMs, Chinese players, especially new ones, are tolerating a higher level of early iteration and user feedback in the field, supported by over-the-air updates.

Questions and responses drawn from Ricardo webinar, “*The next generation of Vehicle Control Software*”, broadcast July 29th 2025.

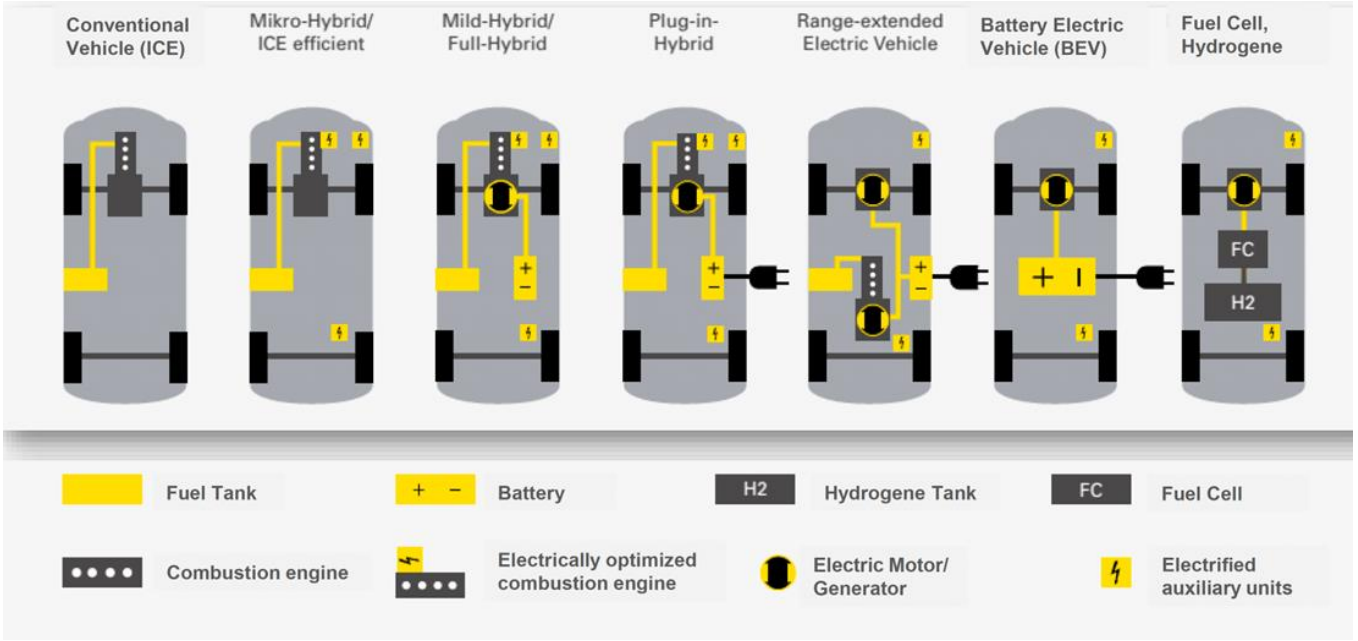
WHAT’S DRIVING CHANGE IN VEHICLE DEVELOPMENT?

Electrification, platform modularization, integration, and software-defined features are reshaping the industry.

Complexity arises from having multiple powertrain architecture options, as shown in the image (right), in addition to the trend towards ‘everything by wire’.

Chinese OEMs have changed the game by compressing development cycles, vertically integrating software and electronics, and launching vehicles packed with smart features faster than traditional players ever expected.

The bar has been raised. It's now a software race as much as a hardware race. OEMs elsewhere need to adapt to this mindset or risk falling behind.



02

The Value Layer

"Without a state-of-the-art vehicle control supervisor, manufacturers risk falling behind".

THE VALUE LAYER

Whilst hardware underpins the vehicle's performance, software controls the experience.

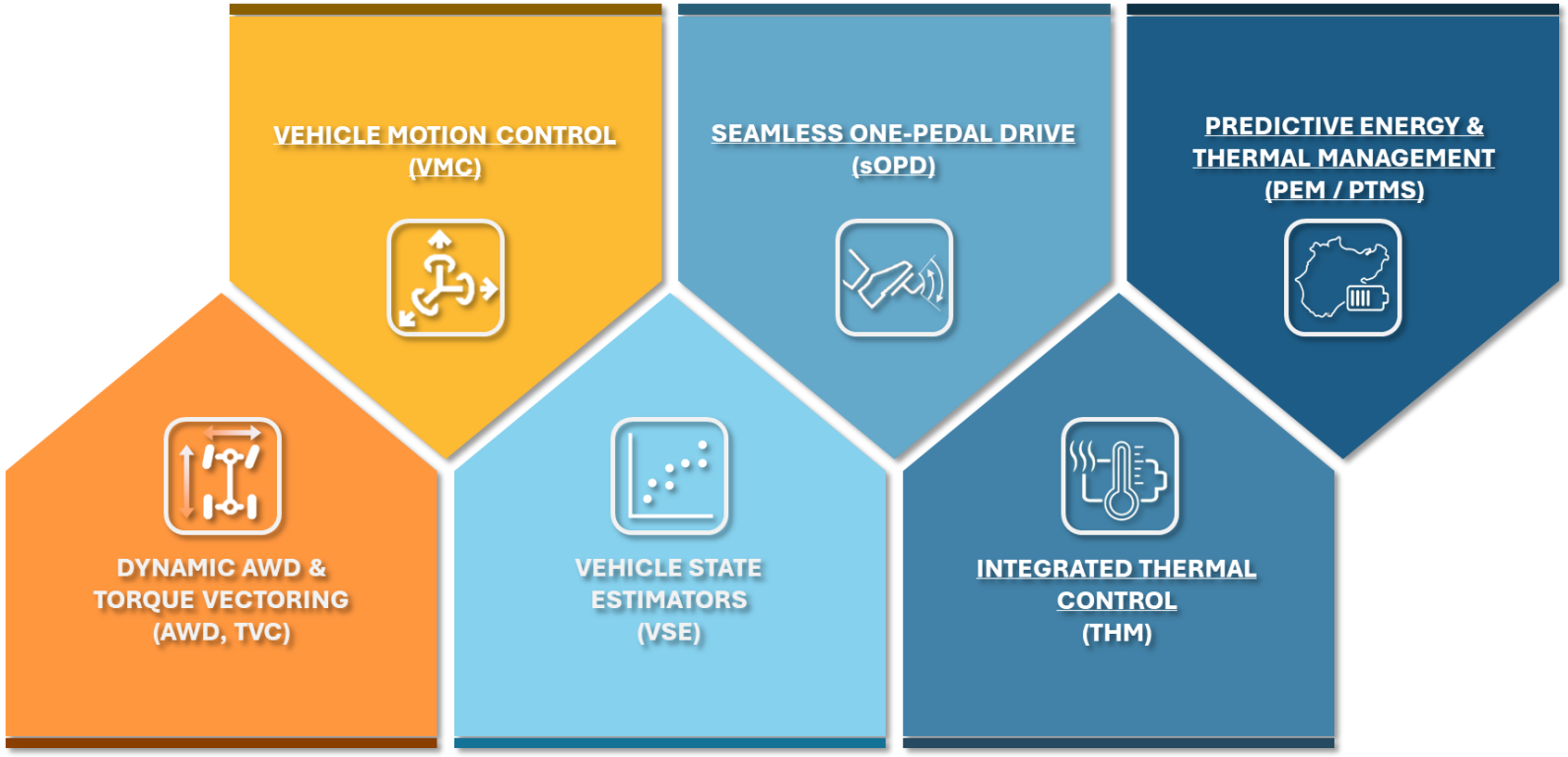
When a customer steps into an EV, they are expecting a comfortable and safe ride, they want to have confidence in the vehicle's driving range, and they need peace of mind that the internal systems are taking care of smart energy management.

If software is the new *value layer* in EVs, then the Vehicle Control System becomes a powerful tool. It's where software, sensors and actuators come together to define how the vehicle moves, how it feels, and how it responds.

THE BRAIN OF THE VEHICLE

Vehicle control supervisor software is a sophisticated high-level control system embedded in the vehicle control unit (VCU).

Essentially, it is the ‘brain’ of the vehicle. It coordinates various systems such as powertrain, braking, steering and sensor systems - unifying a diverse range of functions, processing real-time data from multiple sensors, and making decisions to ensure the vehicle operates efficiently and safely. All of which is undertaken in compliance with standards.



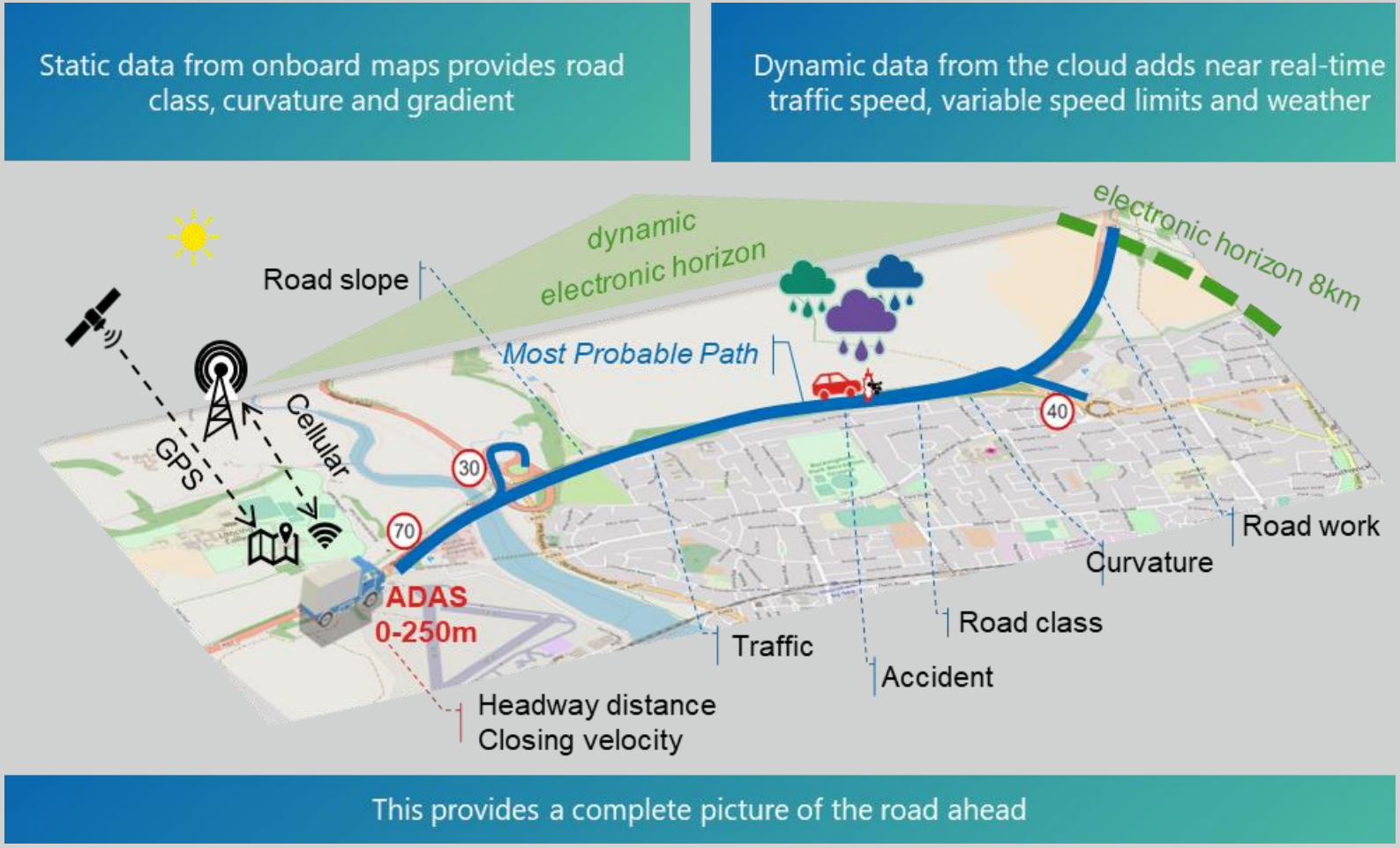
VCU FUNCTIONALITY EXAMPLES

1. Predictive energy management

A VCU can intelligently plan how and when to manage energy on the road.

‘Static’ data – such as from onboard maps - offers information such as road class, curvature and gradient profiles. ‘Dynamic’ data drawn from cloud connectivity, meanwhile, adds real-time traffic conditions, variable speed limits and local weather readings. By using ‘Static’ and ‘Dynamic’ data, the VCU can build a preview of the road ahead and optimise battery state of charge along the route.

The result is extended electric range and reduced fuel consumption of up to 10% in passenger cars, and 15% for heavy duty applications.



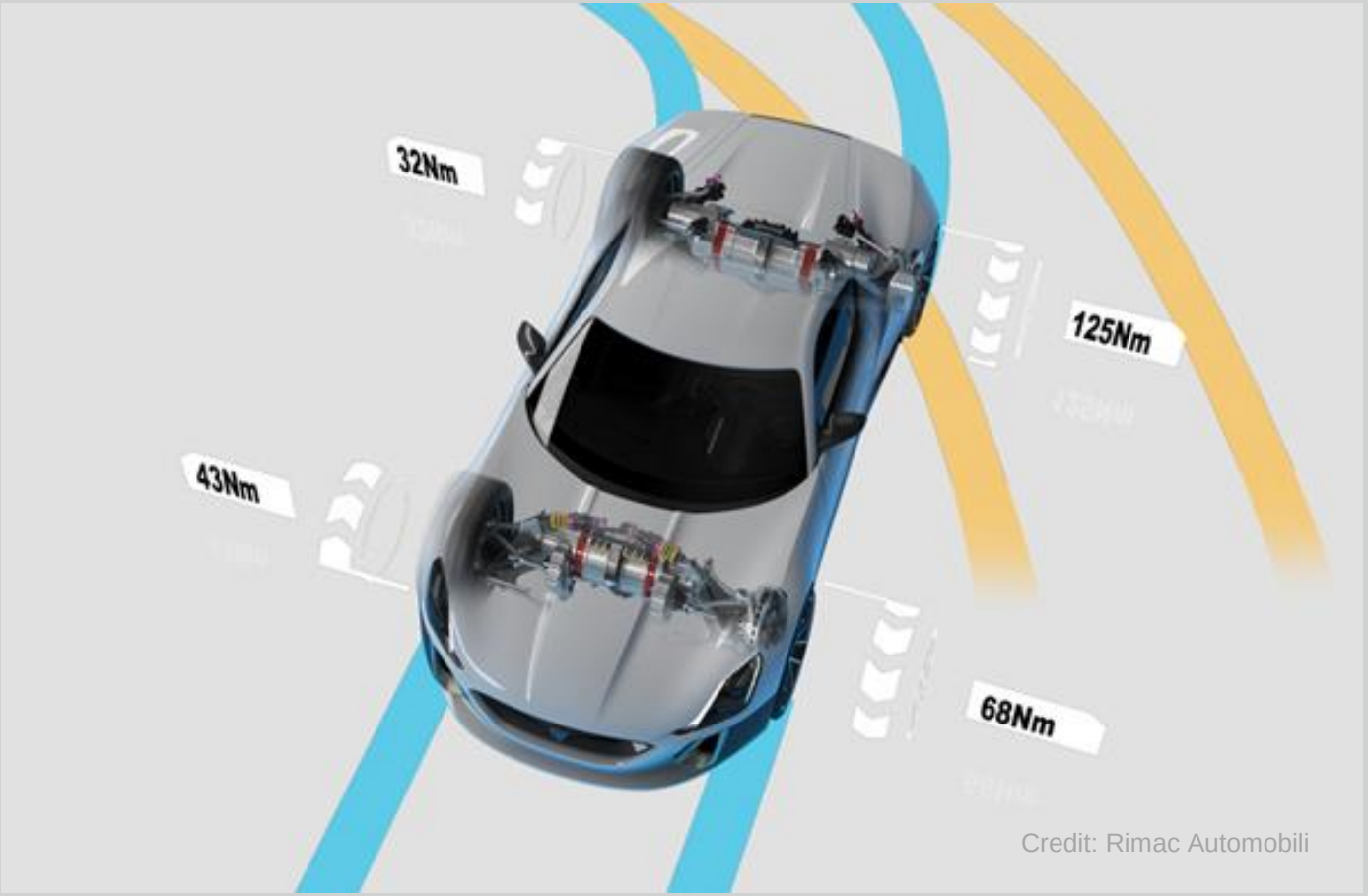
VCU FUNCTIONALITY EXAMPLES

2. Dynamic AWD & Torque Vectoring

The VCU system can distribute torque between the front and rear axle, as well as from the left to the right, to allow a vehicle to respond to changes in road conditions, driver inputs and vehicle dynamics.

This ensures optimum traction, stability and cornering by anticipating and correcting understeer/oversteer, affording the driver improved comfort and confidence.

The benefits extend beyond passenger cars. In commercial vehicles, for example, the VCU can enhance traction on uneven or slippery surfaces, whilst in light mobility platforms it can help reduce the turning radius.



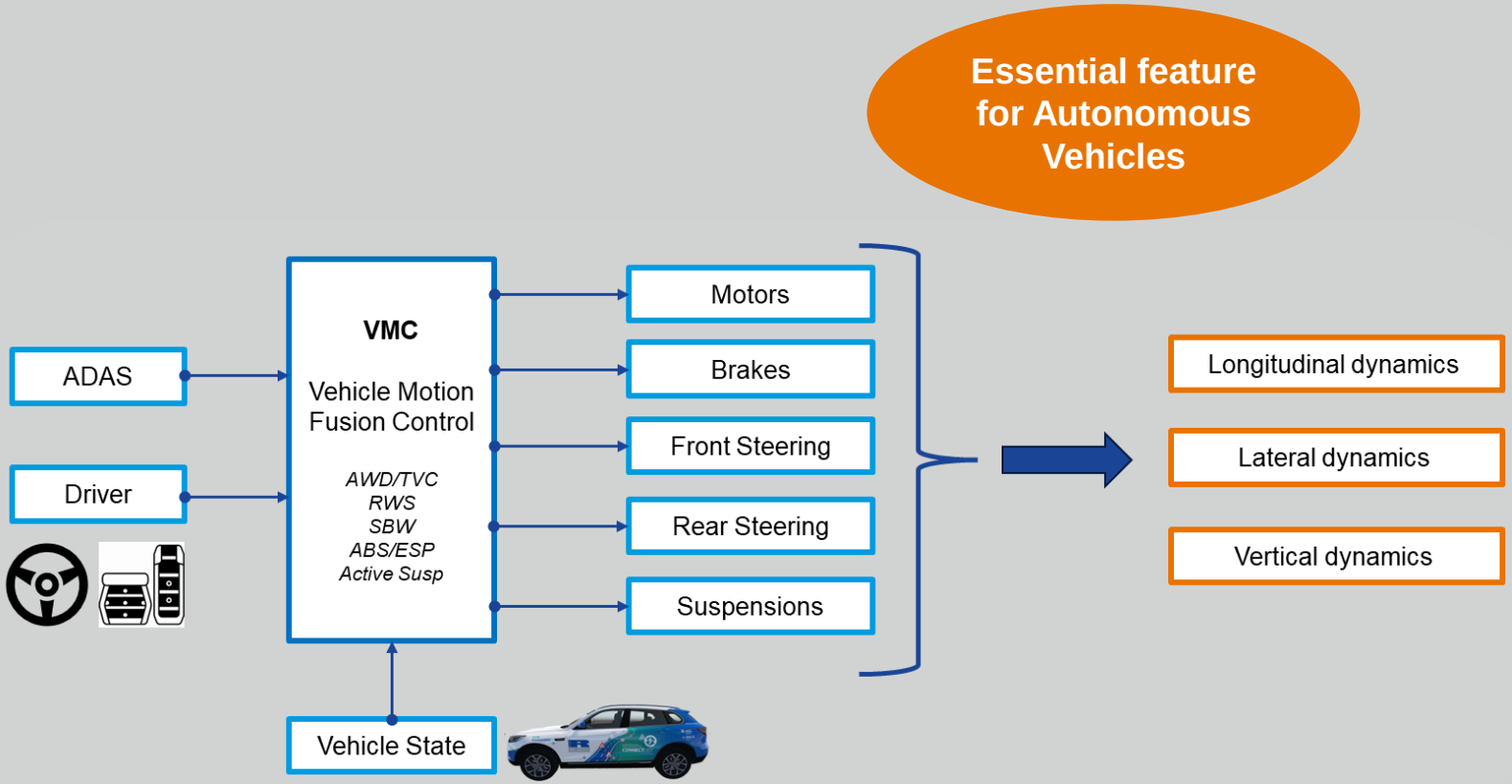
VCU FUNCTIONALITY EXAMPLES

3. Vehicle Motion Control

Vehicle Motion Control (VMC) turns a collection of by-wire systems into a unified, intelligent and responsive vehicle.

It is the integration hub that coordinates multiple ‘by wire’ domains such as braking, steering, suspension and torque control to allow the vehicle to precisely manage the longitudinal, lateral and vertical dynamics simultaneously, optimising acceleration, cornering, stability and ride comfort as one cohesive, holistic system.

This is essential for autonomous vehicles, where consistent, predictable and safe motion behaviour must be safely managed without human input.



Q&A

How does a modular VCS fit with the commercial vehicle industry, which includes a mix of vertically integrated OEMs and Tier Ones?

With a modular vehicle control software there's greater flexibility to adapt the software with fewer changes to a particular vehicle system. Of course, we need to understand what the interfaces are, some of the intricacies etc. But, generally, having a modular architecture makes it easier to swap various components depending on the needs of a particular vehicle architecture.

Within OEMs there is also a trend to ‘in-house’ vehicle control software - instead of using many suppliers - so a modular VCS approach can enhance scalability, reusability and upgradeability.

If you can share various modules or various elements of software across your vehicle product line, then you’ll be more efficient in managing the software development lifecycle.

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WHAT OEMs MUST DO

As vehicles become more intelligent, connected and electrified, handling the complexity of multiple integrated systems can be challenging.

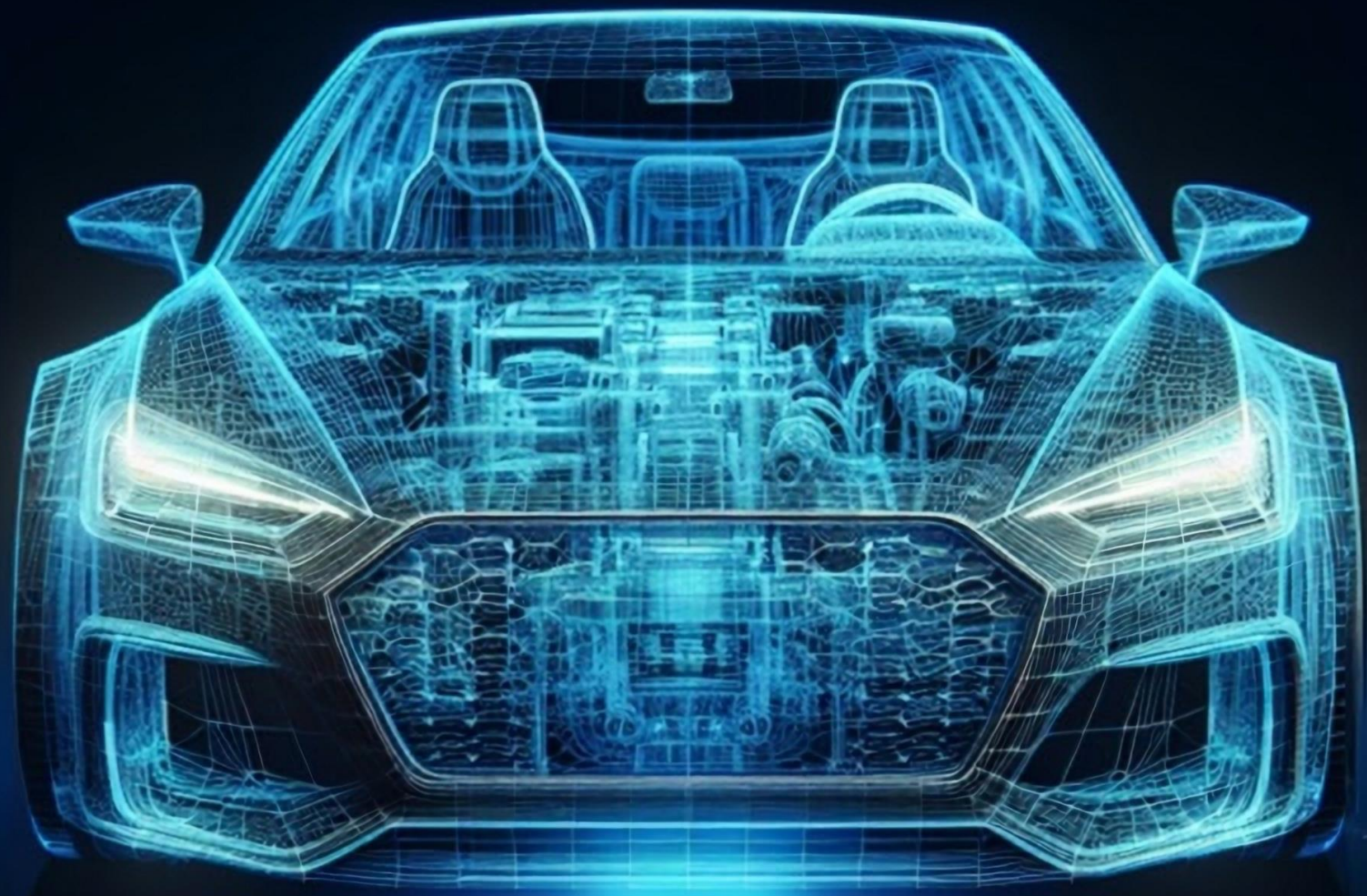
Vehicle control supervisor software acts as the central intelligence needed to coordinate these systems. Without a state-of-the-art vehicle control supervisor, manufacturers risk falling behind in a fast-evolving industry where integration, adaptability and efficiency are key.

For OEMs, maintaining a competitive edge means investing in advanced functions with robust, modular and scalable vehicle control supervisor software platforms that can be adapted across various vehicle types and configurations.

03

RICARDO VICS

“A robust, trusted and proven solution validated with over 40 projects”.



RICARDO VICS

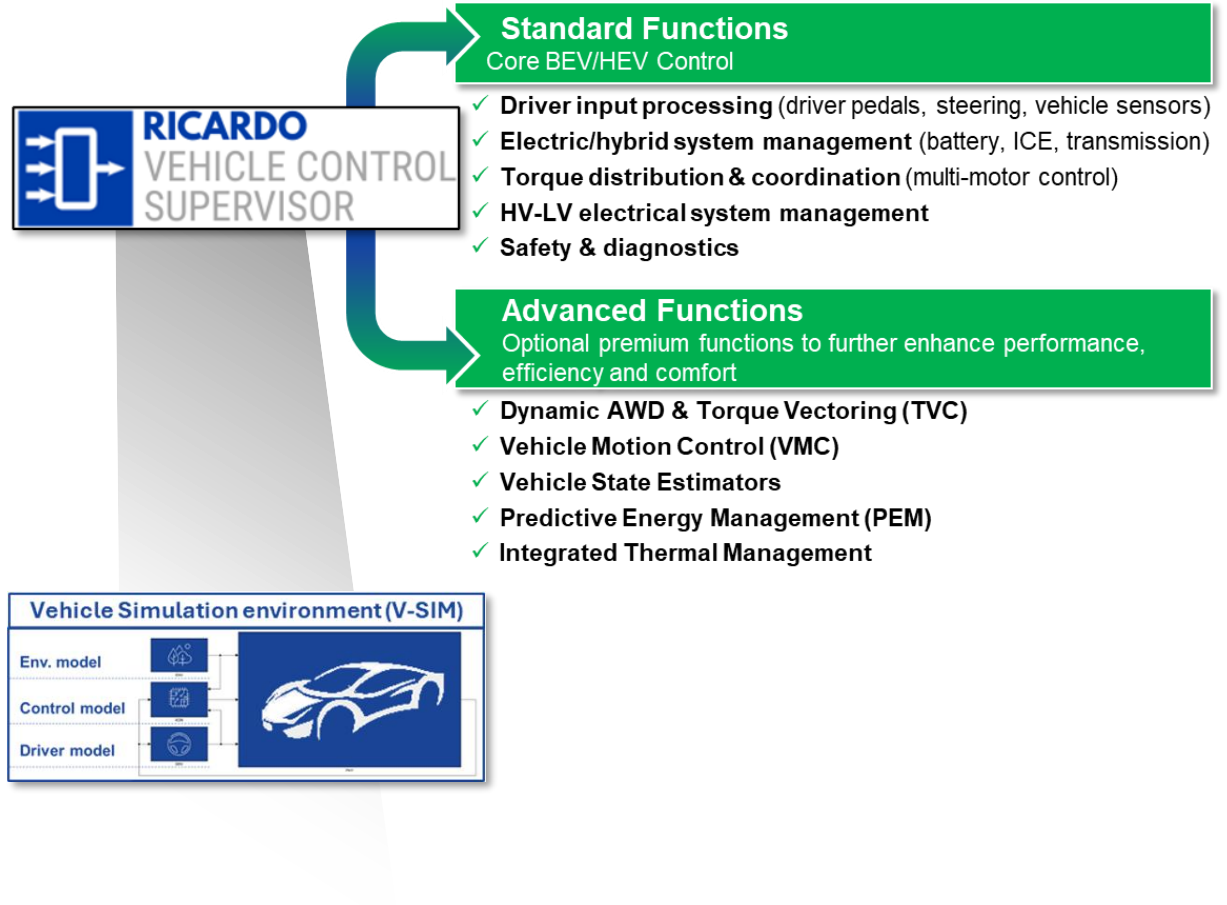
A unified, future-ready platform for a diversified mobility landscape.

Ricardo's Vehicle Integrated Control and Simulation Platform has evolved through more than 40 production programmes and has been validated on everything from compact urban EVs to heavy duty trucks.

It consists of two layers: **the control software**, *Ricardo Vehicle Control Supervisor* (Ric-VCS), which supports standard and advanced functions, and V-SIM, our **vehicle simulation environment**.

A key differentiator is its flexibility. It is compatible with all major power terrain architectures from mild to full hybrids, from P0 to P4, including single and multi motor BEVs, range-extended electric vehicles, and fuel cell vehicles.

This versatility enables customers to standardise software platforms, reduce development time and deploy intelligent control across product lines.



EFFICIENCY, PERFORMANCE AND SAFETY

Ricardo's vehicle supervisor control software is suitable for a wide range of applications, including commercial vehicles, off-highway, special vehicles, passenger car, motorcycles and motorsport, as well as maritime and aerospace.

Efficiency: streamline vehicle development by reducing the time required to build both demonstration and production vehicles.

Performance: ensure precise control over critical vehicle functions; enhance responsiveness, reliability, and overall operational capabilities.

Safety: developed in accordance with relevant industry functional safety standards.

WHY USE RICARDO'S VCS?

- **Minimise costs by 50%** by having full control of your software platform, allowing you to manage future development without relying on external suppliers or paying additional licensing fees.
- **Reduce time to market by 40%** with demonstration vehicles able to be configured in two months and production-ready within one year.
- Full transparency and ability to **tailor a fully developed solution**, including requirements for software, simulation models, test plans, functional safety and diagnostics.
- Optimise and scale with ease, enabling **seamless extensions and upgrades** without compromising functionality.
- A **robust, trusted and proven** solution validated with over 40 customer projects in the last 10 years.

Q&A

Can you explain what ‘platform’ means in the VICS context? Is it a simulation platform or is it the hardware too?

Our VICS solution includes the application software, which we call Ricardo Vehicle Control Supervisor (Ric-VCS), and the V-SIM simulation platform.

Crucially, both the application software (Ric-VCS) and the simulation model (V-SIM) are modular. This flexibility allows us to configure the simulation environment for your specific vehicle application, ensuring it represents real-world performance.

The Ric-VCS can be integrated with almost any commercial hardware, so it is hardware-agnostic.

With ‘platform’ we are referring to the software *and* the simulation environment, not to a particular hardware.

For more information:

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Email: info@ricardo.com

The content of this eBook is based on a webinar hosted by Ricardo in November 2025.