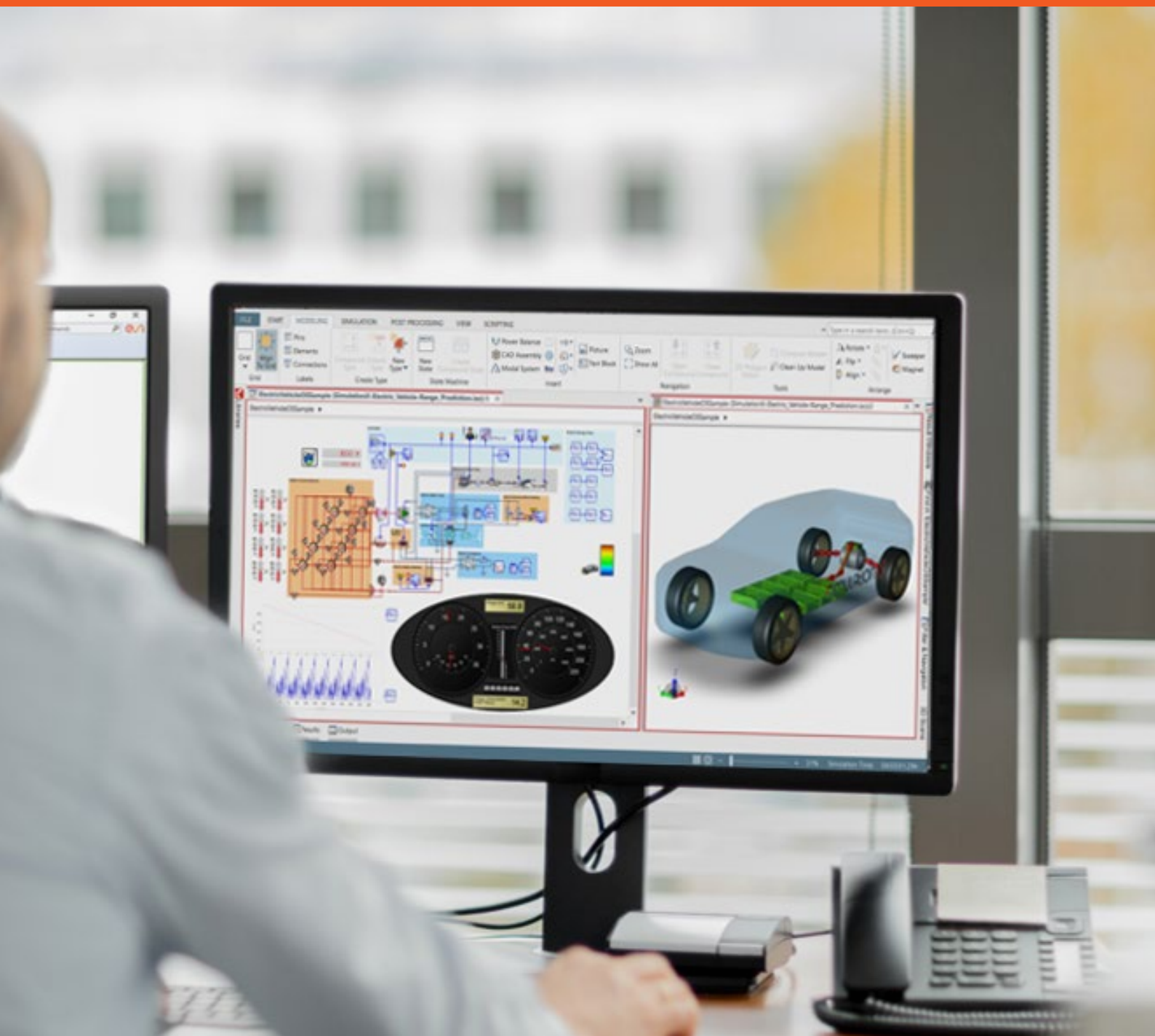
How Virtual Prototyping Accelerates Vehicle Development to Achieve Sustainable Mobility & Meet Mission Zero Goals



> **“Thanks to ESI [...] we succeeded in developing one of our new vehicles, achieving good physical tests right the first time, allowing us to earn the whole five stars on the Euro NCAP safety test, following its stricter protocol launched in 2018.”**
>
> **OLIVIER COLMARD RENAULT**

Image courtesy of Renault

Executive Overview

Industries are placing sustainability at the top of their agenda. Automakers are surely at the forefront, driven by increasing pressure from governments, cities, and consumers to meet zero-emission goals. Today’s citizen wants sustainable mobility solutions from companies who act in a conscious, responsible way. **In a nutshell: It’s all about sustainability**. This is what industries call “Mission Zero”.

ESI partners with industry leaders in leveraging advanced digital technologies to achieve these bold Mission Zero goals. How so? Witness how automakers have started pivoting away from single-point numerical simulation to 100% Virtual Prototyping: they design, engineer, manufacture, assemble and test a new vehicle concept fully virtually – reducing scrap and emissions while introducing more agile and safe operations with a strong focus on the well-being of humans. Getting sustainable practices right, virtually, is the only way forward.

Looking back just a few years ago, who would have thought it would be possible to release a new vehicle on the market with only one regulatory physical crash test? And yet, that’s exactly what **Renault** did when they launched the Clio 5, earning a 5-star rating from the EURO NCAP.

Who would have thought that halfway through a bidding process, an OEM would decide to remove the physical prototype step altogether and, instead, evaluate battery reliability and performance for their electric vehicle virtually, basing their decision on a virtual prototype alone? That’s what happened to **Farasis** and, thanks to Virtual Prototyping, they won a +€10B contract with **Daimler Benz**.

Who would have thought that even during a global pandemic, while employees were limited to working from home, it would be possible to reduce vehicle development time by nearly 10 months? That’s what **Volkswagen do Brazil** achieved by effectively continuing to work in an immersive digital world, developing their vehicle 100% virtually.

How did such a massive disruption of established processes in a very competitive setting come to be and how did these OEMs succeed in emancipating themselves from real tests and prototypes? Let’s look at the concrete example of vehicle safety and reveal the key-enabling functionalities on the simulation side to help you get started on your Virtual Prototyping journey towards more sustainability.

Getting Sustainable Practices Right: Build Trust And Credibility on the Market

According to recent industry research, 60% of companies in the automotive industry already have a clear "Mission Zero" sustainability strategy. However, as though the complexity behind creating next-generation vehicles wasn't challenging enough, OEMs future success depends on their ability to deliver according to their "Mission Zero" promises, both quickly and credibly.

From the consumer's point of view, the demand is simple: they want to buy mobility, not cars. And they don't want to buy just any type of mobility – they want the ultimate "ZERO" sustainable mobility: zero accidents, zero injuries, zero emissions, and zero unplanned stops with hours of charged, maintenance-free range.

On the other hand, although this vision is clear for automakers, the way to get there is anything but simple. Their activities focus on:

- securing delivery and lightweight body chassis
- creating electrified vehicles and batteries
- ensuring safe driving including autonomous vehicle operations
- inventing new passenger experiences
- realizing efficient, operator 4.0-style product assembly lines

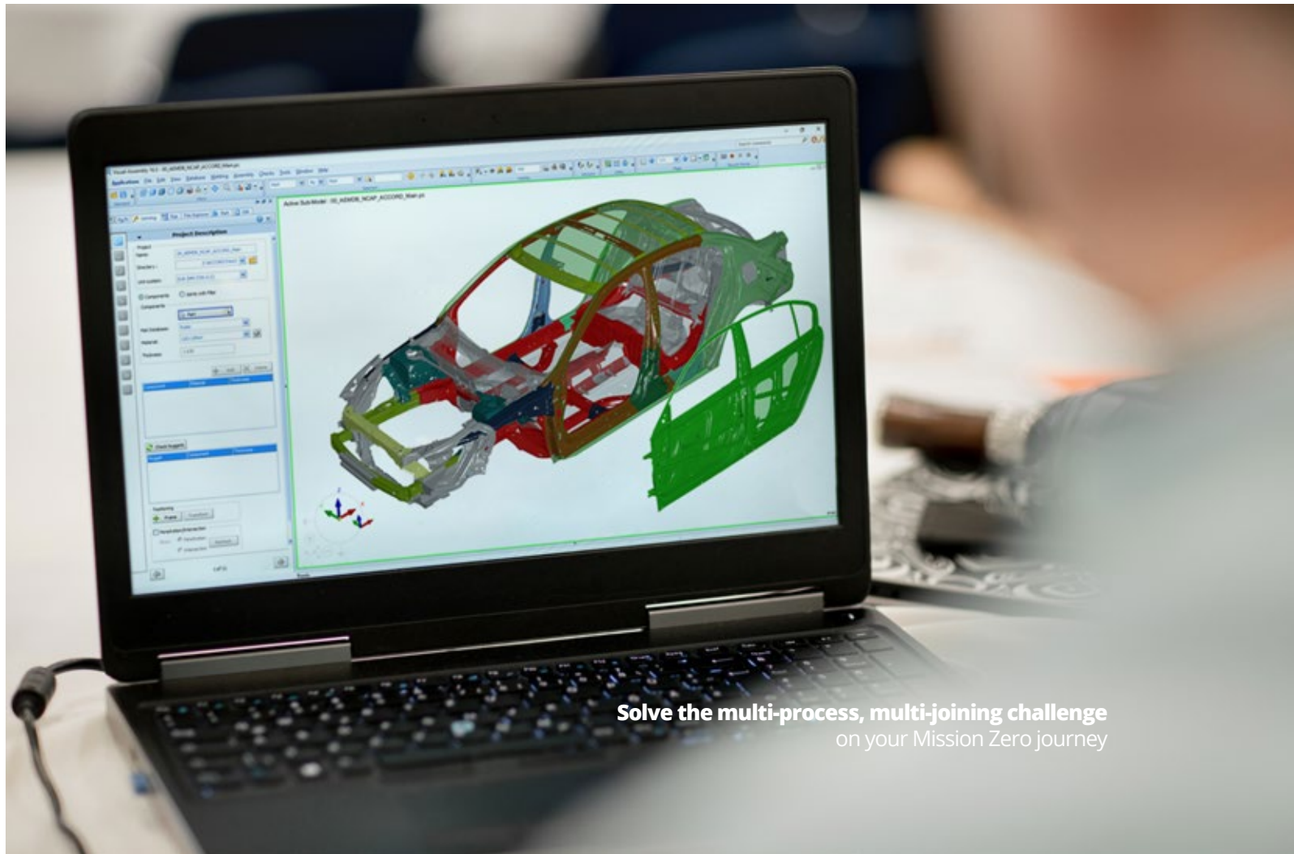
Solving each one of these activities itself is a complex task due to the interoperability and interconnection of the required engineering disciplines. Yet, getting new technologies to market first and establishing trust in their performance before market launch and throughout the lifecycle, OEMs must figure out all these outcomes equally and commit early with confidence. This adds complexity on top of complexity.

Commitment to Mission Safety

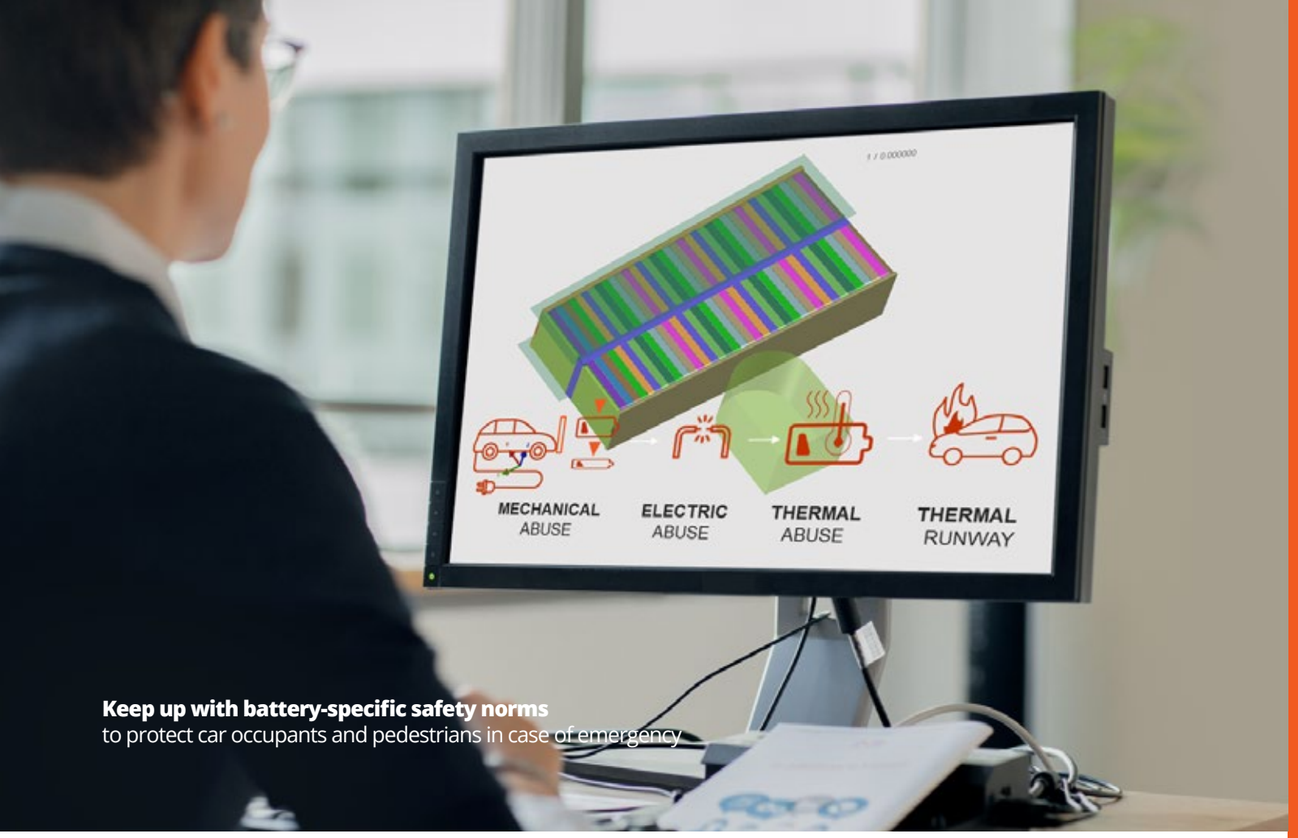
A commitment like this entails being able to anticipate the way next-generation vehicles operate in various and uncertain use conditions. Let's look at EV safety to make things clearer.

New future mobility technologies have spurred a new wave of regulations for active and passive safety, to which automotive manufacturers and suppliers must adhere to be able to commit to overall safety – and they must do so with extensive verification and validation in a wide range of environments and circumstances.

Just take the example of lightweight: With regards to reducing carbon footprints, the rise of mixed materials impacts all product and manufacturing engineering domains. However, it requires the complex balancing of cost/ lightweight trade-offs across all the various interconnected vehicle systems. Automakers need to have early confidence in the strength of these new multi-materials (e.g. in safety-critical vehicle components) but also ensure performances in durability of chassis and prevent failure in service life.



Solve the multi-process, multi-joining challenge
on your Mission Zero journey



Keep up with battery-specific safety norms
to protect car occupants and pedestrians in case of emergency

Lightweight also impacts domains, like noise, vibration, & harshness (NVH) and drivability & handling, and even vehicle crash test certification. Furthermore, the advent of high-performance batteries and advanced driver-assistance systems (ADAS) affects the drivability and handling of the vehicle and its powertrain performance. As you can see, the performance and development of each of these systems are dependent on one other – a seemingly insignificant design change in one area could impact all other areas of the vehicle.

Simulation and analysis must reflect this reality, allowing designers to clearly visualize the consequences of their design decisions across multiple systems. Otherwise, the verification and validation results are not aligned, engineers will need to continue relying on physical testing thus undermining the entire commitment to the safety certification process and sustainability goals. Automakers know that they need to act fast and be able to venture into unchartered territory; They need to make confident decisions about the lifetime performance of their vehicle and deliver on the Vision ZERO promise – right from the beginning of development.

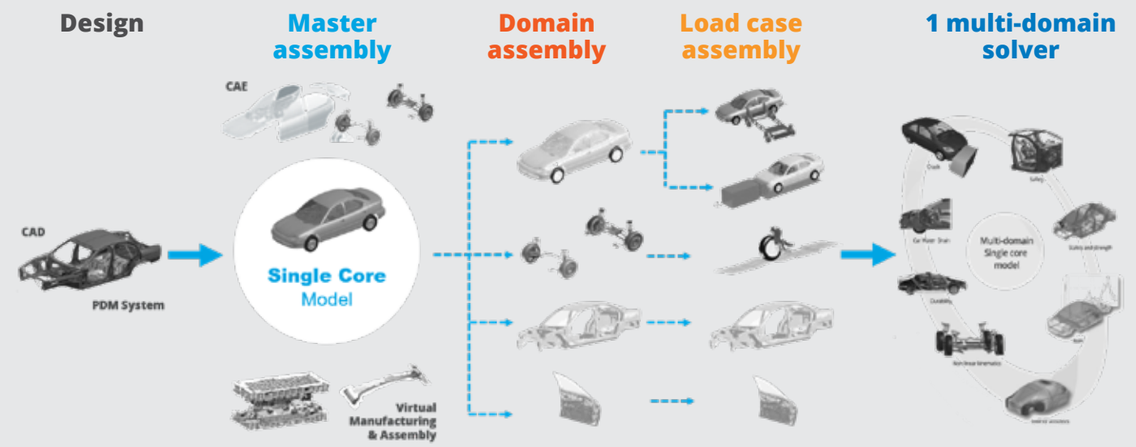
The attitude OEMs must acquire to embark on their ambitious sustainable mobility scenarios: 'We must get safety certification done without real tests and prototypes and we must get it done right the first time'. The KEY is Virtual Prototyping.

Take a moment and think about what the numerical response of the existing PLM approach is to your daily work challenges. Do you believe you need more simulation tools rather than new rules for developing and manufacturing future vehicles?

"The consistent chaining of virtual manufacturing results and virtual performance for crash and safety as well as for NVH and durability is a definite technological breakthrough, ensuring the right levels of product performance for lightweight design."

EISEI HIGICHI HONDA R&D

Move Towards Sustainable Engineering: Virtual Prototyping and the Single Core Model Facilitate Your Zero Physical Prototype Journey



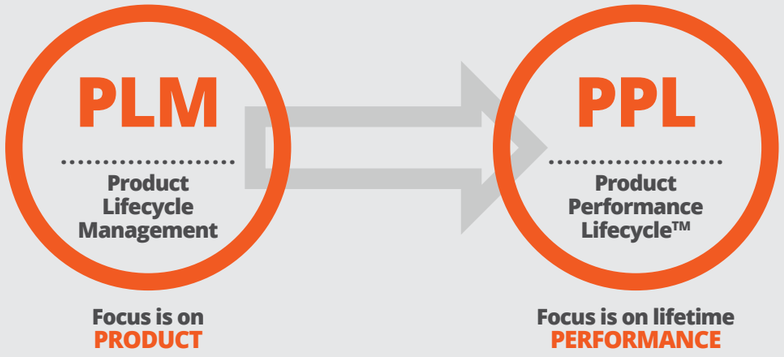
When a vehicle is tested, its behavior is validated across multiple engineering domains, including material stiffness & strength, crash & safety, NVH & durability, acoustics, comfort, and more. Traditionally, each engineering domain has its own set of technologies, methods, and processes in place to run its own simulations, separately from the other domains. However, each domain has the same end goal: to predict the vehicle's response in order to validate the design before conducting any physical tests.

For example, NVH, battery development, and crash & safety teams each need to assess the performance of the vehicle chassis. Each team works independently with a different core focus – the NVH development team investigates how the chassis design affects the sound quality of the vehicle, the battery development team tests the safety of the battery with the chassis design for compliance with regulations, and the crash & safety team wants to achieve a high crash test rating.

Each team works with a different set of analysis methods, processes, models, and solvers. They take the input data, process it using a domain-specific set of algorithms, and obtain an output that corresponds to the result of the analysis. This data is then transformed into a form the engineers can understand. This approach has been refined by engineering teams for years.

Fact: PLM has its limits. In a nutshell, the missing benefit lies in the inability to run simulations across all the involved domains, faster, while also making sure each one is synchronized and consistent with every functional detail of the CASE system.

The Single-Core Modelling Approach
bridges silos in current industry PLM workflows



Achieve Efficiency and ROI on Your Mission Zero Journey

Virtual Prototyping and the management of the Product Performance Lifecycle is a path that we, at ESI, walk together with industry leaders towards the ability to commit early and with confidence to the diverse sustainability goals around Mission Zero – both for product development and manufacturing processes as well as for the performance of an asset in service.

The basis of the Virtual Prototype is that it is realistic and predictive; it is a true representation of the vehicle. A virtual prototype is based on multi-domain simulation models and captures ESI's unique treasure of material physics. Supplemented by advanced Virtual Reality, engineers experience their latest designs in full immersion prior to production. It gives engineers the ability to virtually experiment with real data and real physics at the same time.

Thanks to this extra degree of freedom, engineers can digitally demonstrate the reliability, safety, and energy efficiency of their new vehicle technology upfront in the development cycle and achieve pre-certification right the first time. This is how they emancipate from real test and pre-production prototypes.

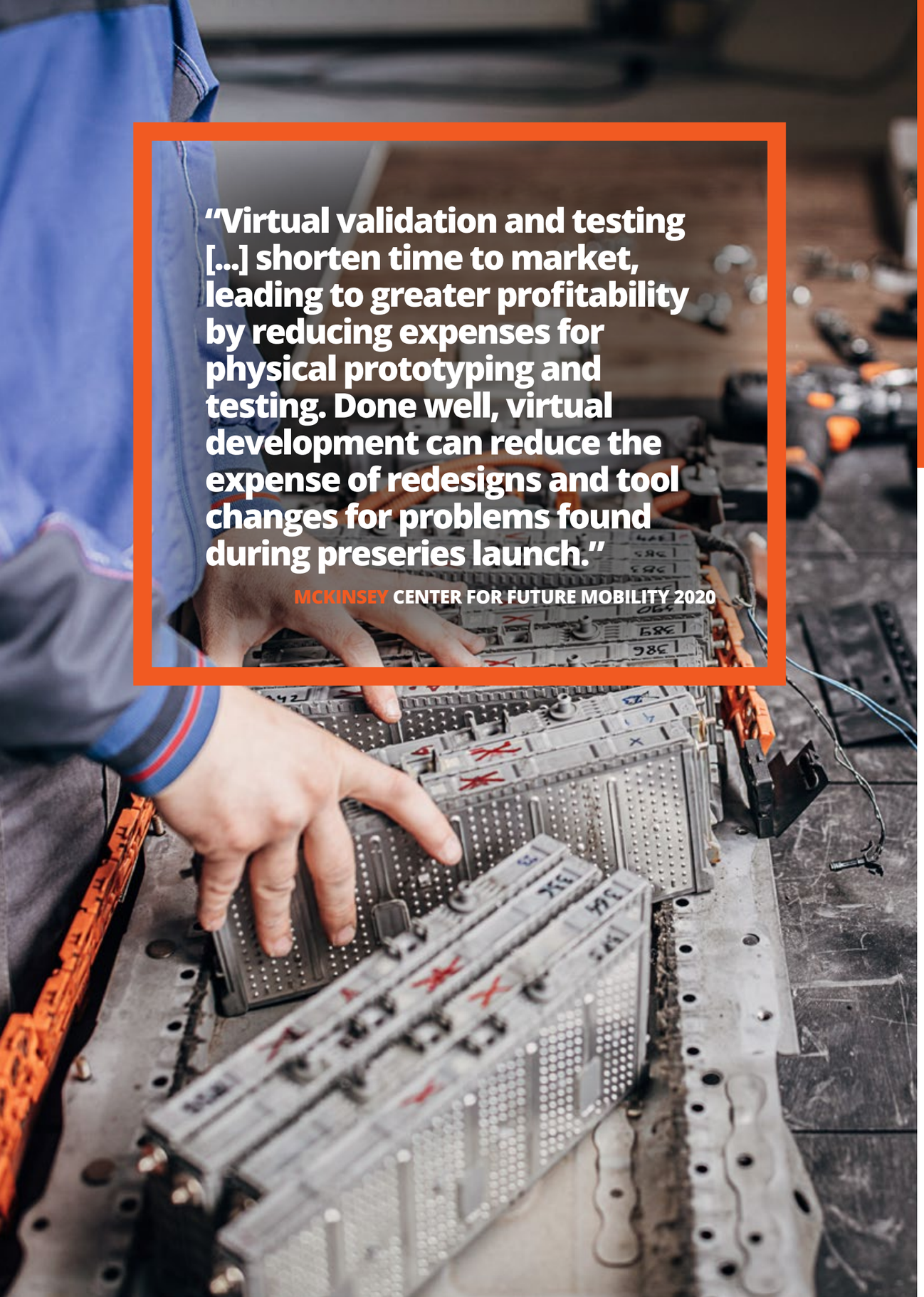
The heart of the Virtual Prototype is a "Single Core Model" in which iterations happen simultaneously across all customer domains, overcoming the limits of common but inefficient 'assembly line' approaches.

The Single Core Model combines 3D computer-aided design (CAD) models, virtual manufacturing, and assembly simulations.

That Single Core Model is then built into other computer-aided engineering (CAE) analysis models across multiple engineering domains. Under a single definition of the analysis, every simulation stakeholder now contributes to and extends this Single Core Model into each of their own domains. Compared to the established single-point 'art of modeling', the Single Core Model facilitates a new, end-to-end 'art of decision-making' with which companies efficiently manage the complexity of simulations across multi-domain product development.

As a result, automotive R&D organizations can digitally experience and validate the fabrication, assembly, and behavior of their future vehicle in different environments, early and throughout the entire product lifecycle – in a sustainable, zero scrap way.

Design complexity is replaced by consistency to optimize the performance of the final product and the automotive organization is free to pursue innovation without the risk of disruption and in a financially-sustainable way.



> **"Virtual validation and testing [...] shorten time to market, leading to greater profitability by reducing expenses for physical prototyping and testing. Done well, virtual development can reduce the expense of redesigns and tool changes for problems found during preseries launch."**
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> MCKINSEY CENTER FOR FUTURE MOBILITY 2020

Enable Sustainable and Healthy Development of New Energy Vehicles for Safe Mobility

What's the key takeaway in a nutshell? Operating 100% virtual in an end-to-end fashion, with one single source of truth, is truly sustainable and the key to realizing Mission Zero with the speed and confidence to be credible in the eyes of consumers.

Virtual Prototyping is all about combining engineering expertise and advanced virtual capabilities to start exploring equipment performance fully virtually - with minimum physical prototypes and tests. All this is not about us being right but rather about our customers getting it right.

The successes of **Farasis, Honda, Renault, Volkswagen do Brazil** and many more in the electrified mobility field of play demonstrate the value that Virtual Prototyping brings when collaborating in an end-to-end fashion and making intelligent decisions with simple, precise visualizations to share between different teams.

What drives us and keeps us walking this path with you is the common purpose we share: enabling sustainable, safe and reliable future mobility.

Engage with us and talk about how we can help you get it right the first time.

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