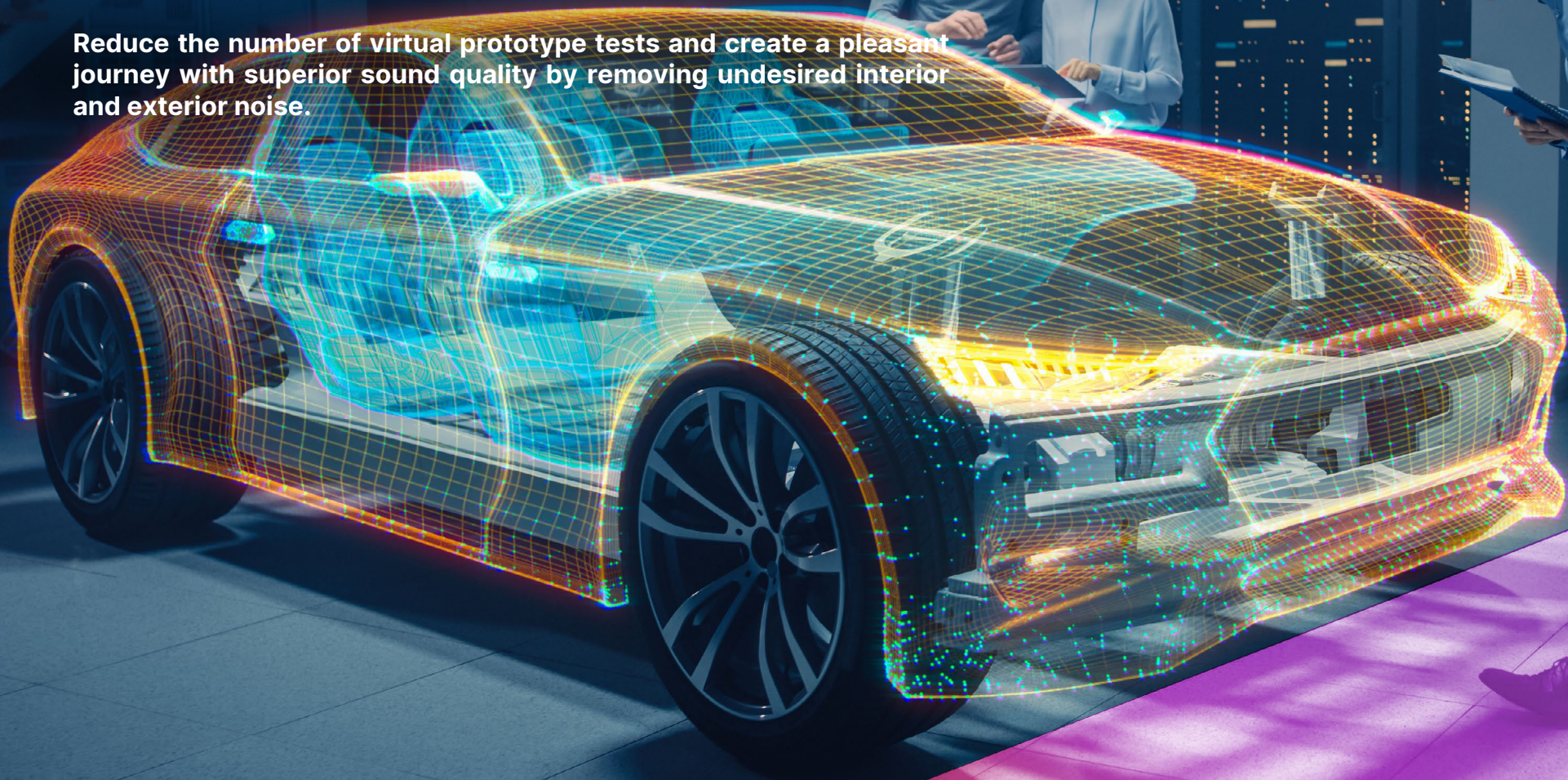




# Achieve an Optimal Vehicle Acoustic Experience.

Reduce the number of virtual prototype tests and create a pleasant journey with superior sound quality by removing undesired interior and exterior noise.



## Introduction.

Vibroacoustics engineers face tough **challenges in optimizing the noise of lightweight electrified vehicles**. With the absence of traditional combustion engine noise, unwanted vibrations and acoustic disturbances become more prominent inside the cabin while the challenge of meeting pass-by-noise regulations persists.

Moreover, acoustic engineers must find ways to purposely create noise around the new silence to protect vulnerable road users in EV traffic with effective acoustic warning systems. **Tight development timelines and R&D budget constraints can only be met with a first-time-right engineering approach.**

Yet, how can acoustic engineers figure out all these outcomes simultaneously and get early confidence in the optimal design, given that it needs extensive prototype testing and validation cycles to achieve the desired acoustic performance?

To efficiently solve the complex acoustic engineering challenges at scale and reduce emissions, testing mileage, tooling & material cost, a paradigm shift is needed in vehicle development: Engineers must **virtually assess the full acoustic performance of the final vehicle**, exploiting predictive, physics-powered simulation technologies, and **reducing reliance on limited physical testing.**

**By reading this e-book, you will gain insights into the latest advancements in EV acoustics engineering and discover how Keysight Vibro-Acoustics (VA One) revolutionize your approach to testing and development.**

### Kearney expects that ...

the consequent use of simulation for hardware prototype reduction can save up to



**3 months development time**



**10% development costs**

Source: <https://www.kearney.com/digital/article/-/insights/automotive-product-development-how-to-become-faster-and-cheaper-through-digitalization> as of May 16, 2023

# Imagine the convenience of a digital wind tunnel.

At Keysight, we envision a future where a digital test track offers an alternative to extensive physical testing.

Take a moment and think about what the response of your existing engineering approach is to your daily work challenges:



Can you efficiently meet the evolving regulations for new vehicle designs today?



When being tasked with delivering safe vehicles, can you validate the acoustic performance of your designs right away without having to wait for physical prototypes?



Can you predict the influence of trim components for your company's new lightweight electric vehicle early and accurately?



During wind tunnel studies, does your design match all performance criteria in order to achieve certification right away?

**If you only answered 'no' to any of the above, it's definitely time to bring your EV acoustic engineering to the next level!**

**Do you believe you need more simulation tools rather than new rules for developing future vehicles?**

Here are a few reasons why automakers should consider eliminating physical prototype builds from the test and certification of acoustic vehicle performance:

Increased cost and time efficiency

Greater flexibility with rapid iteration

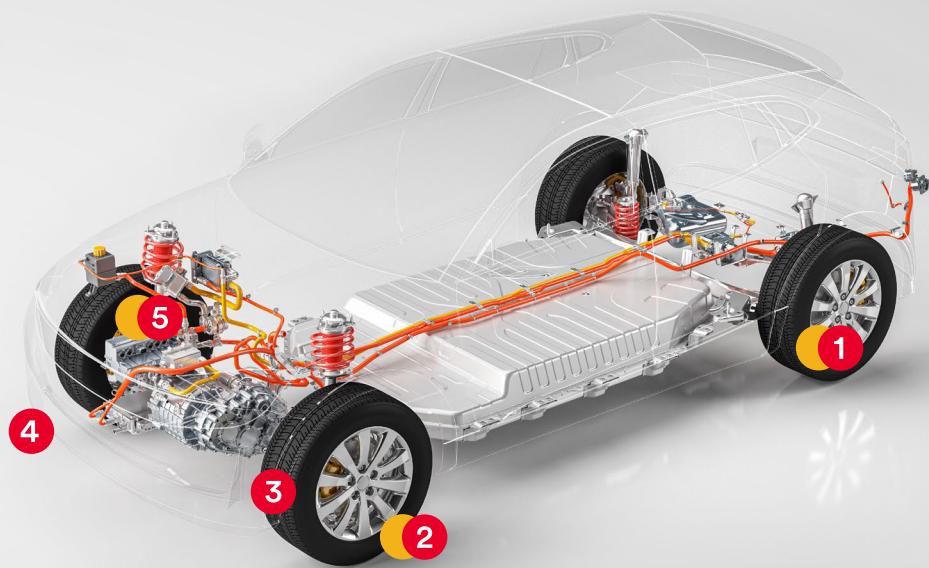
Lower environment impact

Accuracy and predictability


Safety and compliance right the first time

Data-driven, early decision making






# Harness the power of your very own digital test facility.



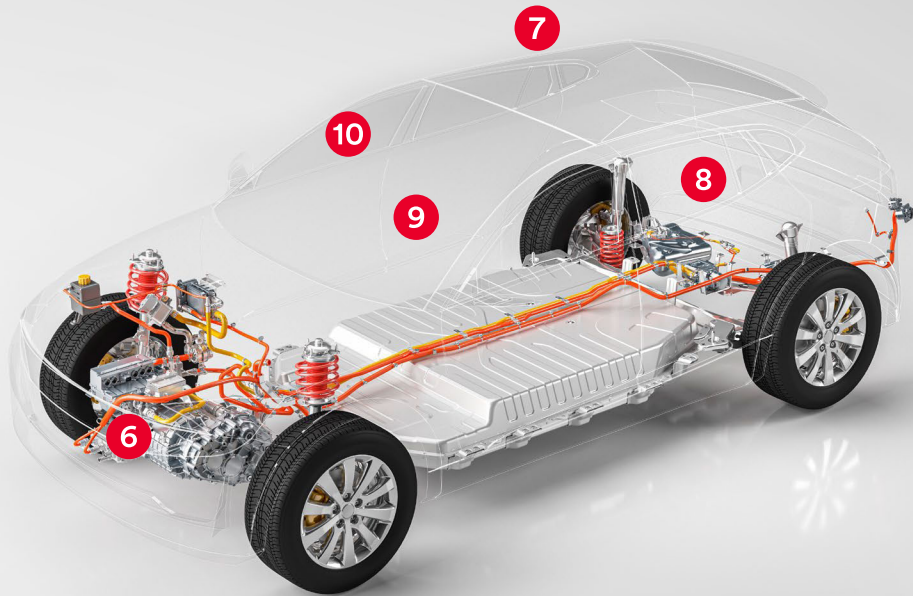
 Exterior Noise

 Interior Noise

## Going fully digital in acoustic testing of exterior and interior noise:

-  **Airborne Noise** Vibroacoustic simulation predicts how noise control treatments affect airborne noise transmission to optimize the design for maximum acoustic comfort and minimum external noise transmission.
-  **Road Noise** Vibroacoustic simulation predicts road noise and optimizes the acoustic design for maximum acoustic performance.
-  **PBN** Vibroacoustic simulation predicts exterior acoustic performance to meet noise regulations, considering the impact of the sound package.
-  **AVAS** Vibroacoustic simulation predicts Acoustic Vehicle Alerting System performance and supports choosing the best sound actuator position.
-  **Encapsulation** Vibroacoustic simulation predicts how the different encapsulation configurations of the electric motors and powertrain affect the interior and exterior acoustic performance of the vehicle.

# Harness the power of your very own digital test facility.



## Going fully digital in acoustic testing of interior noise:

- 6 Structure Borne-Noise** Vibroacoustic simulation predicts structure-borne noise across the entire frequency range.
- 7 Sound Package Design and Optimization** Vibroacoustic simulation predicts how noise control treatments affect overall vehicle acoustic performance, considering cost, weight, and packaging space.
- 8 Speech Clarity** Vibroacoustic simulation predicts speech clarity and how to optimize the acoustic design for maximum speech intelligibility and minimal background noise interference.
- 9 Auralization** Vibroacoustic simulation predicts how transfer paths and acoustic treatments interact to create a perceived sound and allows for subjective evaluations of interior acoustics prior to physical testing.
- 10 Wind Noise** Vibroacoustic simulation predicts the effect of wind noise on acoustic comfort by integrating CFD data into the models of the car.



Interior Noise

# Hit your regulatory and performance targets for exterior noise using Keysight Vibro-Acoustics (VA One)

Electric Vehicles represent new acoustic challenges to automotive designers, with **pedestrian safety** being a central issue. Leading automotive OEMs and their suppliers use Keysight Vibro-Acoustics (VA One) to **evaluate design options as early as possible in the product development cycle**.

**Engineering teams use Keysight Vibro-Acoustics (VA One) in external noise testing to holistically improve vehicle acoustic design performance:**

- Enable regulation testing and qualification virtually.
- Reduce design & verification cycles.
- Understand the impact of tires and powertrain contributions on exterior noise.
- Choose effective AVAS location strategies to ensure regulatory compliance.
- Meet Pass-by-Noise (PBN) regulations effectively and at a controlled cost.

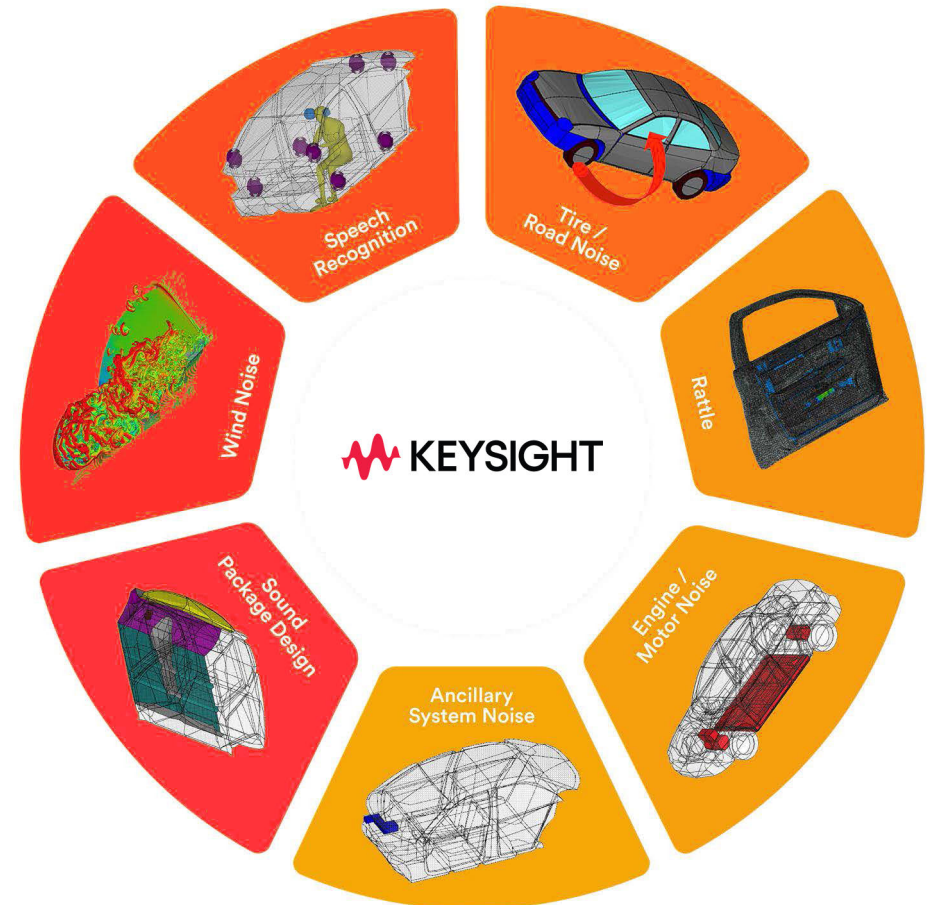


# Deliver the best possible in-cabin experience, while meeting weight and cost constraints.

Supporting concurrent engineering, Keysight Vibro-Acoustics (VA One) delivers **accurate results**, at the **right point** in the design cycle **reducing** the need for costly rework.

**With Keysight Vibro-Acoustics (VA One), acoustic engineers all over the world avoid expensive delays by removing undesired interior noise in the early design stages:**

- Collaborative trim optimization.
- Enhance speech clarity and infotainment systems.
- Reduce buzz, squeak, and rattle.
- Analyze new transmission paths for EVs.
- Minimize powertrain noise.
- Predict wind noise.

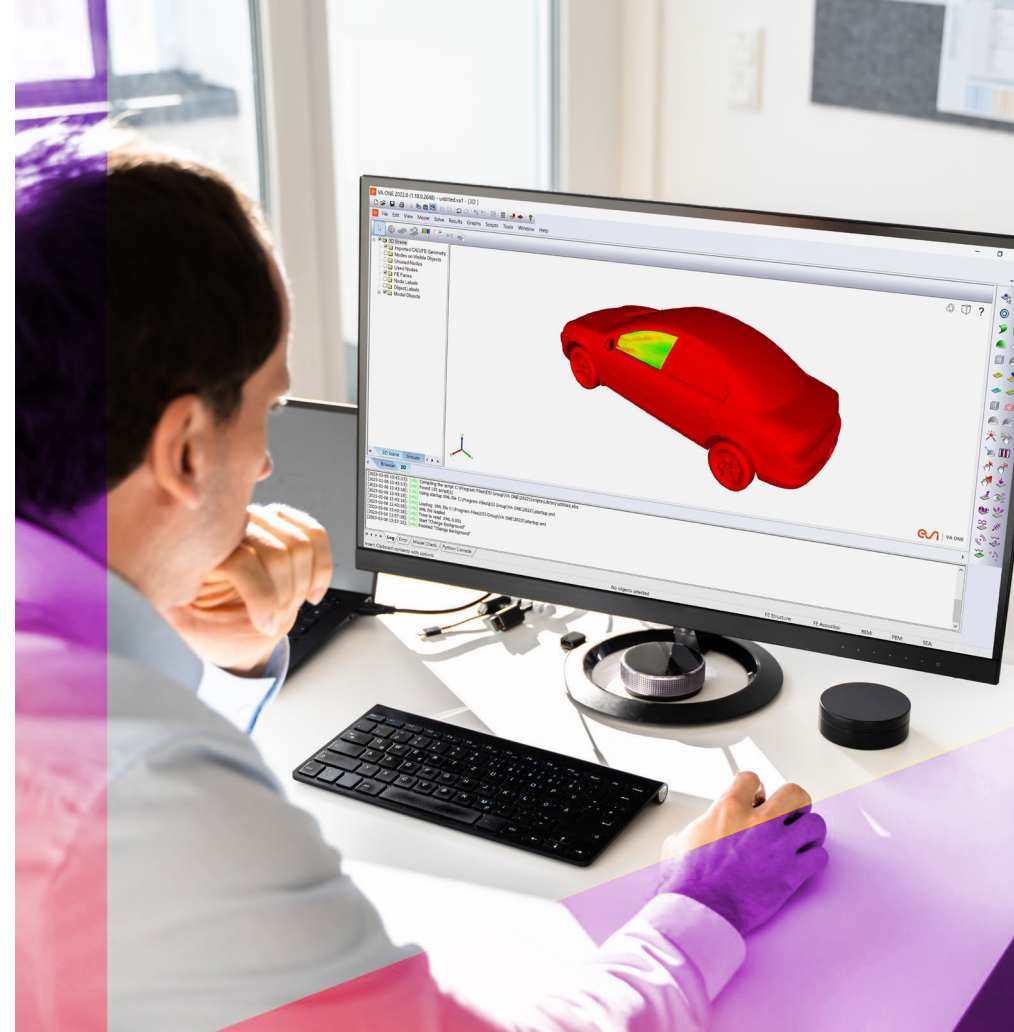


# Predictive, fully virtual vibroacoustics testing.

At Keysight, we envision a future where a digital test track offers an alternative to extensive physical testing. In the field of vibroacoustic engineering, automakers all over the world use our simulation software Keysight Vibro-Acoustics (VA One) to digitally demonstrate and pre-certify the acoustic performance of new vehicles upfront in the development cycle.

Here are the main features of Keysight Vibro-Acoustics (VA One) for interior and exterior noise testing at a glance:

- 1 Advanced NVH & Acoustics modeling across the full-frequency range** for structure-borne and airborne noise alike.
- 2 Fast computation with ray tracing** enables rapid, accurate analysis of noise transfer compared with traditional deterministic tools.
- 3 Built-in library of materials models and physical properties** provides highly accurate noise predictions ensuring early confidence in compliance with noise
- 4 One single development environment** easy-to-use for virtual EV testing and validation, reducing the need for training on multiple platforms.
- 5 Highest accuracy with a broad range of analysis methods to a range of +-3dB** for SEA including FEM & BEM.



**For about three decades, Keysight Vibro-Acoustics (VA One) has been the de facto standard simulation tool at most acoustic engineer's desks in the automotive industry.**

**Chad Musser, Keysight Vibro-Acoustics (VA One) Director**

# It's not about us being right – it's about our customers getting it right.

Virtual vibroacoustic testing is key to ensuring that new vehicle designs meet the required standards and hit their performance and cost goals. For about three decades, Keysight Vibro-Acoustics (VA One) has been the de facto standard simulation tool at most acoustic engineers' desks for efficiently optimizing ANY potential noise source across the full-frequency range in one single development environment.

## 01

### German OEMs Maximizes the Driving Range & Acoustic Quality of the New e-tron

Tackling structural and airborne noise issues early in the development process helps **prevent unnecessary iteration loops** resulting in **dramatic costs** if dealt with **at late notice** - when performing physical measurements or worse, at physical prototyping stage.

## 02

### British OEMs and Keysight work together to refine the Flying Spur

Advanced virtual design processes have been used in the testing and production cycles of the third Flying Spur generation. Thanks to Keysight's virtual prototyping, a **weight optimization program for the Flying Spur** could be undertaken on **40 different components**.

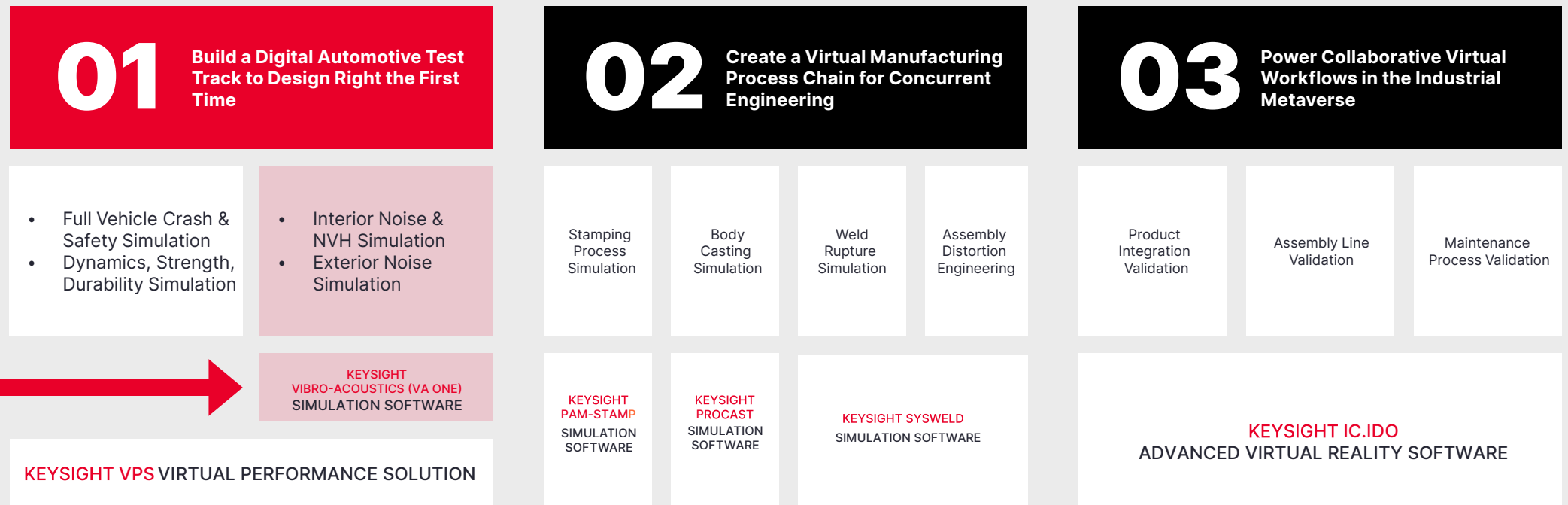
## 03

### US military Uses Simulation to Reduce Noise Inside Ground Vehicles

The customer will continue to utilize Keysight Vibro-Acoustics (VA One) to accurately size Active Noise Cancellation (ANC) systems for new applications, **cutting down on development time** by eliminating iterations, which equals a reduction time of **roughly 75%** for the customer applications.

# How Keysight empowers you to accelerate the development of clean, safe, productive EVs.

Our predictive, real-time, immersive physics-powered simulation solutions, combined with our extensive talent and intellectual property, help you solve complex simulation tasks at scale and save valuable time, resources, and money by avoiding costly and limited physical testing.



Expert inquiry

Case studies & best practices

Peer connections

Live webinars & training events

Live conferences



# Keysight. Innovation Without Compromise.

Over the last five decades, we have been pushing the limits of what's possible.

- We are **pioneers of a virtual-first approach** to solve the most complex and critical problems with simulation.
- Our **legacy of innovation** dates back to our first predictive simulated automotive crash test in 1985.
- We continue to **lead the way** with product assembly reviews in **the industrial metaverse**.

We believe that the diversity of people, perspectives, and experiences is our superpower.

When our **international teams** come together, we unleash our **creative potential** to protect what matters most – our people and our planet.

A passion for protecting our future.

We believe in **sustainable product innovation**, efficient **manufacturing** processes, and simulation-proven physical testing, to help create products that are clean throughout their lifetime with a smaller environmental footprint.

Unlocking true potential with human creativity.

Our **technology and expertise** are focused on helping companies work smarter, reducing costs, improving quality and productivity, accelerating time to market, and improving product lifetime and industrial performance.

Trusted to create a safer world.

We are **trusted** to create a safer world, and our work is critical to some of the **biggest brands on the planet** to ensure drivers, passengers, pedestrians, and workers' daily lives are ever safer.



# With vision comes opportunity.

Our clients rely on us to assist them in building a safer, cleaner, and more productive world. We take that trust seriously, and it drives us to be the best we can be. By staying ahead of the curve, embracing innovation and sustainability without compromise. We are Keysight and together, we can shape the future of industry, and the world, for the better.

# Engage with us!



**Keysight** enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at [www.keysight.com](http://www.keysight.com).

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