Virtual Tyre Evaluation

RE:NISSAN

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Project Purpose

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01

Cost reduction

Can our toolset be used to support and reduce physical testing requirements?

02

Time reduction

Are virtual methods quicker than physical testing? Can testing start earlier?

03

Quality improvement

Do virtual methods improve the final product?

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Nissan Technical Centre Europe – Digital Lab

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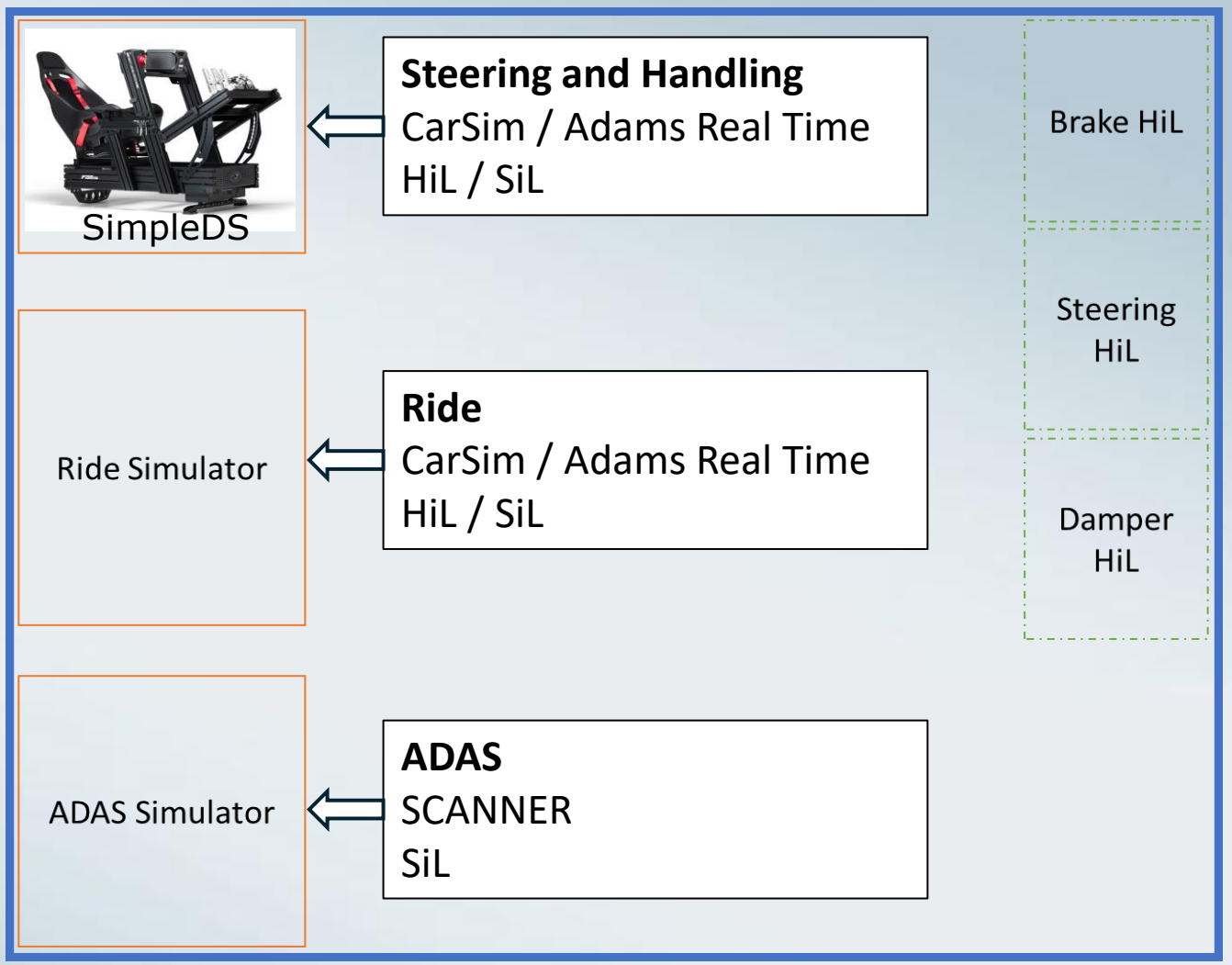
Nissan's region lead approach

Capability as of FY25

▲ 30% Faster

▲ 25% Cheaper



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HORIBA MIRA - Driving Simulator Centre

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HORIBA MIRA - Driving Simulator Centre

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A comprehensive offering combining a proving ground and driving simulator centre at a single location, complemented by state-of-the-art facilities, vehicle development and simulation capabilities.

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Project Outline

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Simple Driving Simulator

- Cost efficient for local needs
- Representative for steering and handling
- Representative for low frequency ride

HORIBA MIRA Motion Simulator (VI-grade DiM 250)

- Fully representative for steering and handling with large motion envelope
- Representative for full range of ride
- Turnkey solution

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Project Outline - Tyre evaluation methods

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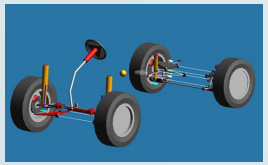
		Vehicle	Tyre
Physical	 MIRA Proving Ground	 Qashqai e-Power	 Bridgestone prototype tyre
Virtual	Desktop simulation	carSIM MECHANICAL SIMULATION CarSim vehicle model	MF + CDTire tyre models
	 NTCE SimpleDS	carSIM MECHANICAL SIMULATION CarSim vehicle model	MF tyre models
	 MIRA DiM250	 Adams/Car vehicle model	PAC2002 + CDTire tyre models

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Vehicle model

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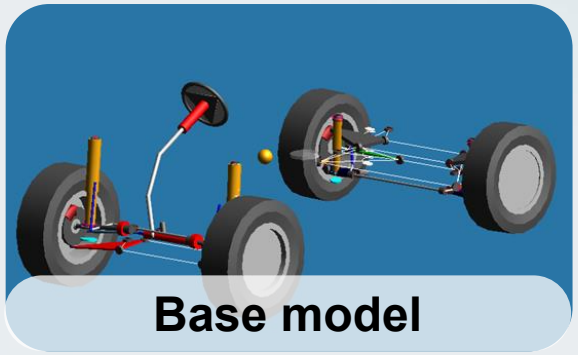

Base model

Adams Real Time cadence

- Populated using Nissan-supplied data (hp, bushings, springs, dampers)
- Validated against K&C measurements and full-vehicle objective test data
- Advanced steering implementation to match real vehicle feel

Tyre model

- **PAC2002** used for the handling events cadence
- **CDTire** used for ride events VIRTUAL TIRE TECHNOLOGIES

Additional systems

- Advanced steering system
- Basic EV powertrain model and sound
- Simple brake system

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Aligned Virtual–Physical Schedule

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1 – Test schedule planning

- The Nissan subjective tyre evaluation schedule was translated into repeatable tests for HORIBA MIRA Proving Ground and the simulator.
- Events were grouped into Handling and Ride to optimise time, maintain driver focus and reduce fatigue.

2 – Motion cueing setup

- Back-to-back proving ground and simulator sessions enabled cueing calibration.
- Drivers aligned on a common setup, with a few key adjustments:
  - Steady-state cornering required a lateral offset
  - Ride events used 100% vertical scaling

3 –Study execution

- The full evaluation was completed over four days,
  mornings on the proving ground and afternoons on the simulator.

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Assessment Process - Handling

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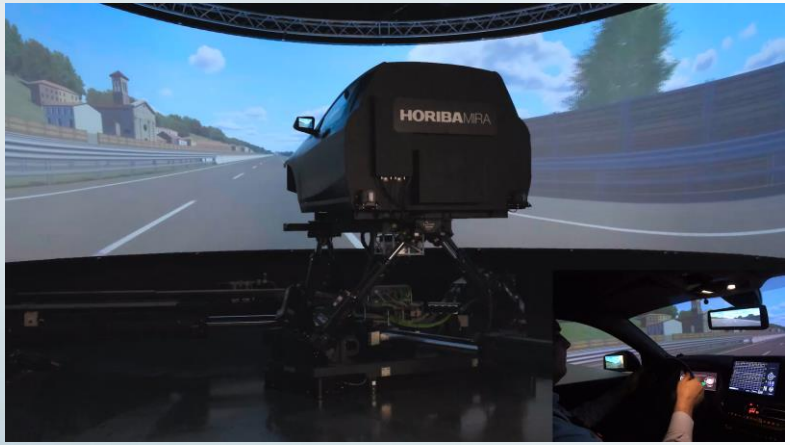
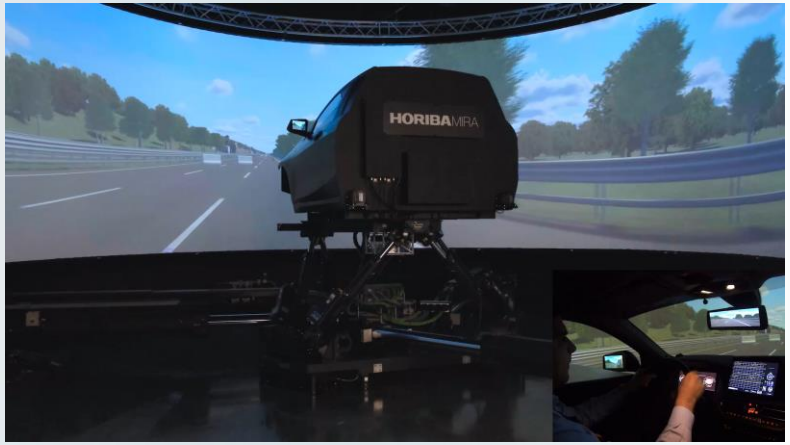


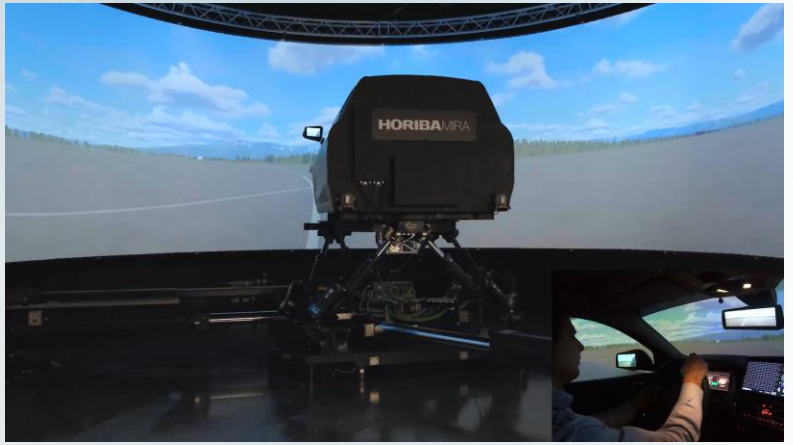
Slalom Steering

- On-centre feeling
- Line tracing
- Steering efforts



Double Lane Change

- Dynamic grip limit
- Yaw damping



Constant Radius Cornering

- Yaw gain
- Handling balance (grip)

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Assessment Process - Ride

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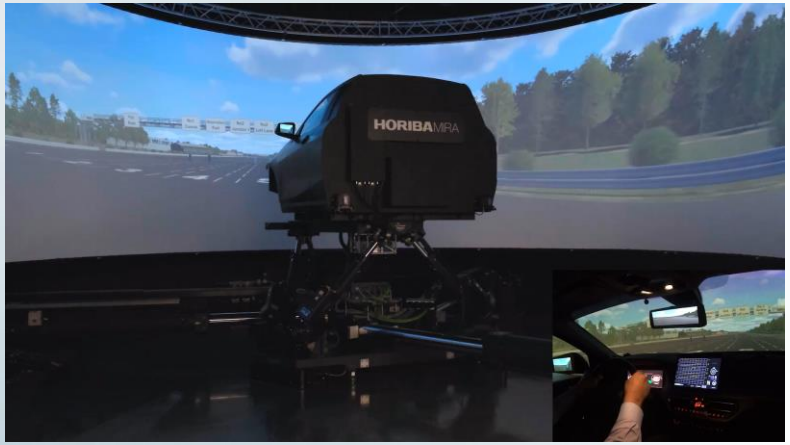
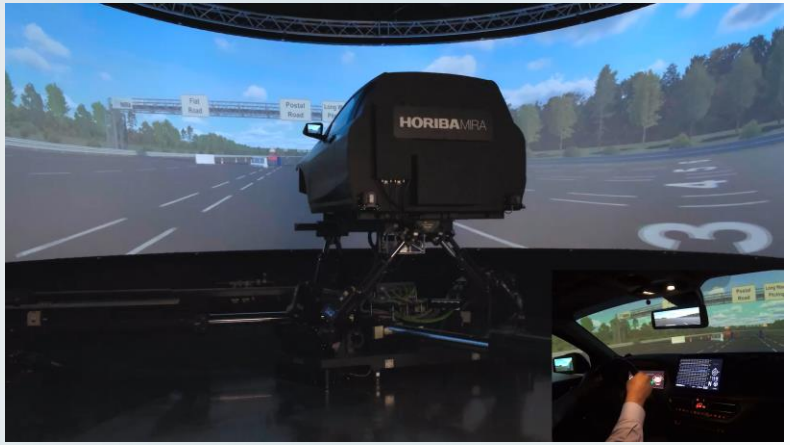


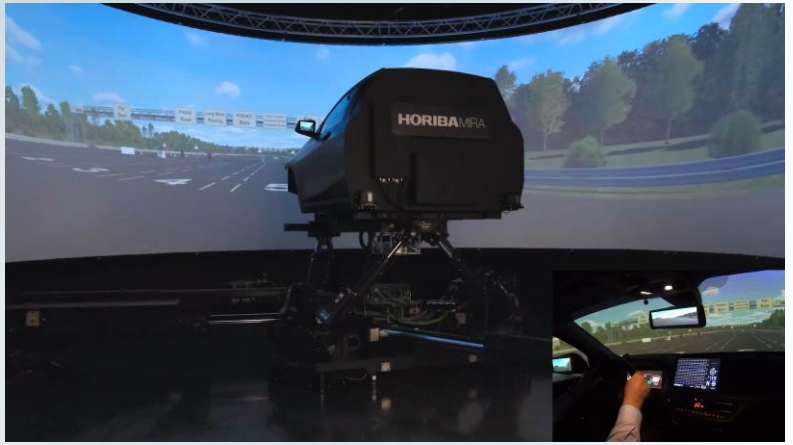
Track #2 Left Lane

Smooth road vibration level evaluation.



Postal Road

Evaluation of comfort on a rough road scenario.



Negative Impacts Speed bumps

Shock and damping harshness evaluation

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Results - Handling

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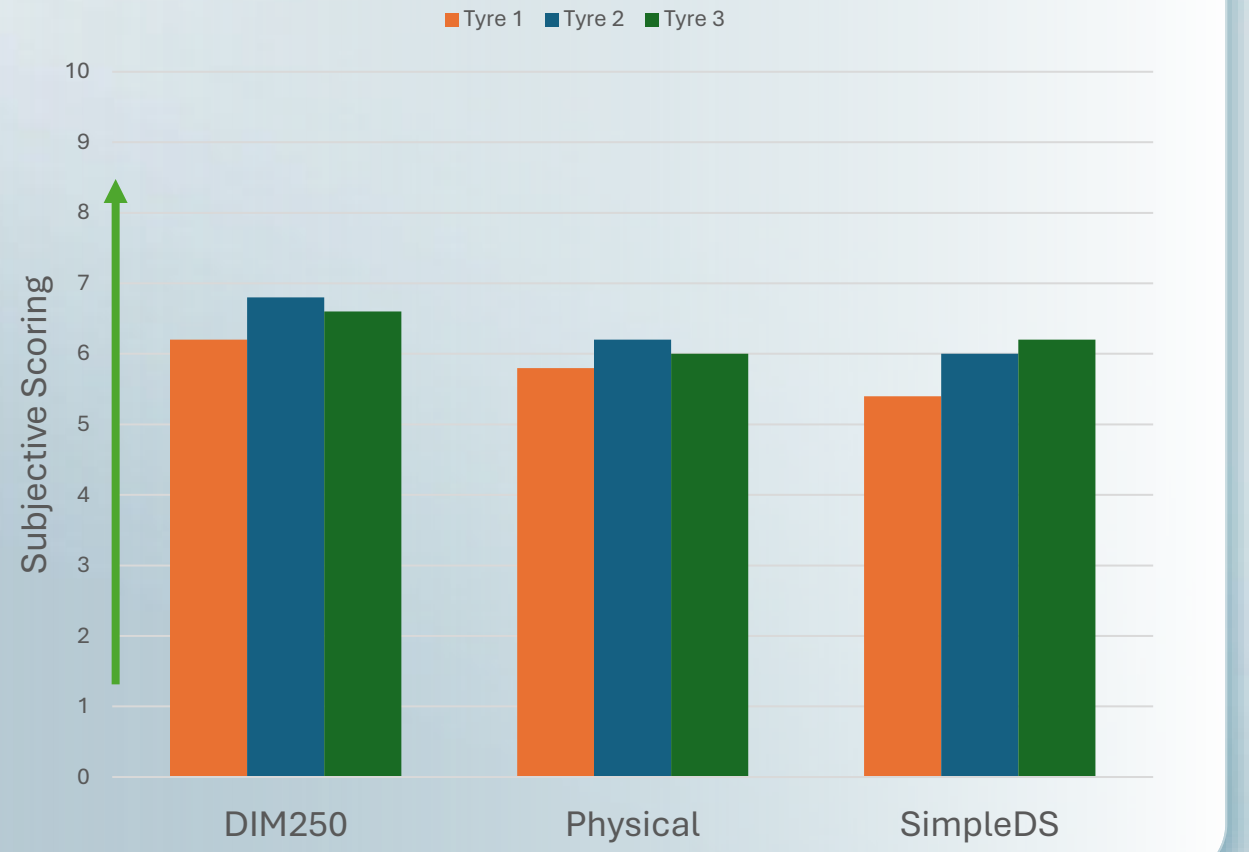
The subjective results match the objective prediction



Objective Handling - Tyre Comparison

Description	Steering	Handling
Tuning Spec #1		
Tuning Spec #2	6% ▲	6% ▲
Tuning Spec #3	6% ▲	6% ▲

- Tyre 2/3 recommend
- DIM vs. Physical vs. SimpleDS performance matches directional improvement
- Subjective evaluation matches objective prediction

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Results - Ride

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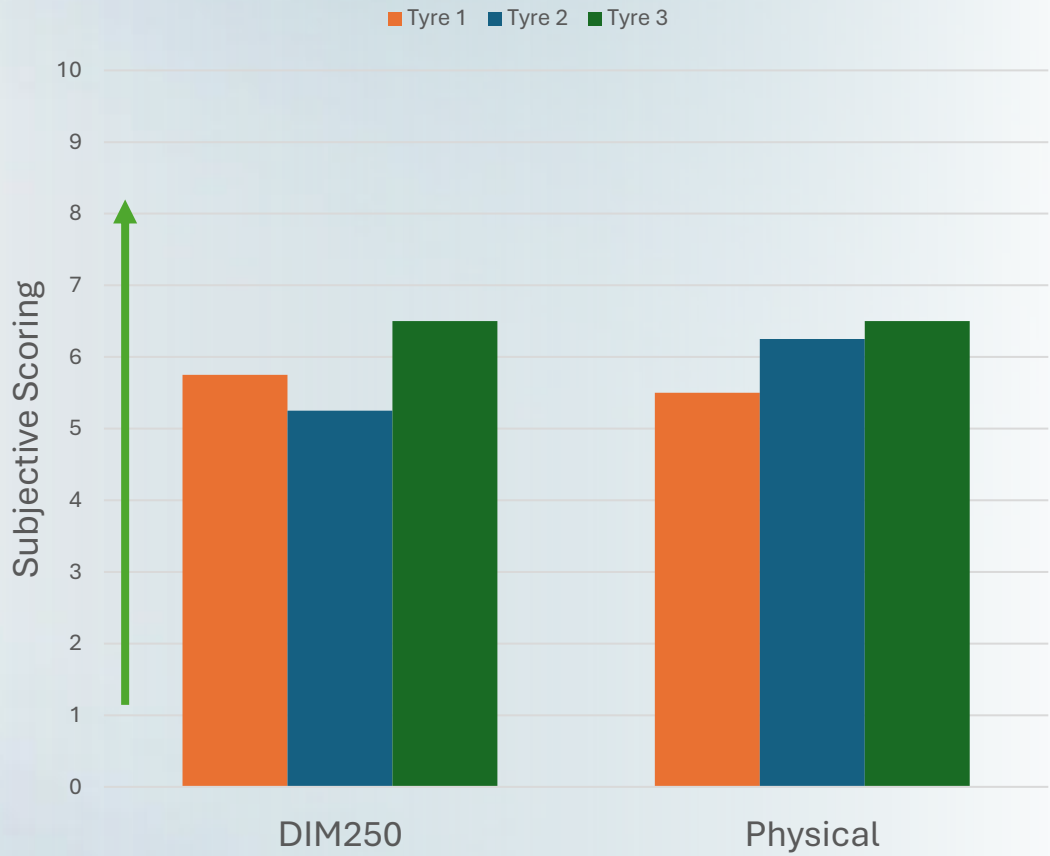
Quick spec changes improve accuracy

Objective Ride - Tyre Comparison

Description	Ride
Tuning Spec #1	
Tuning Spec #2	-0.5%
Tuning Spec #3	+4.3%

- Virtual evaluation correlates better, due to shorter intervals between specs.



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Results – Supplier Comparison

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Supplier A vs. Supplier B

Description	Mass	Belt width	Vertical Stiffness	Lateral Stiffness	Long Stiffness	Cp	Cf Max
Supplier A baseline	10.7 kg	224.7mm	233.1N/mm	140.5N/mm	308.9N/mm	1.84kN/deg	4.65kN
Supplier A max delta	-4.3%	+6.1%	-4.3%	6%	3%	2%	4%
Supplier B delta	11 kg (3%)	196mm (13%)	279.5N/mm (20%)	147.2N/mm (5%)	365.5N/mm (18%)	1.63kN/deg (11%)	5.55kN (19%)

- 2 suppliers with the same targets achieve a >10% delta in spec
- 1 supplier attempting different approaches to achieve the same targets, results in a <10% delta in spec

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Summary

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01

Less down time

Back-to-back evaluations are completed with shorter intervals, improving subjective consistency.

02

Quality

Virtual evaluations are consistent with physical results and objective predictions.

03

Method Assessment

Different tools are suitable for different purposes. Applications need to consider the capabilities.

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Nissan's Future

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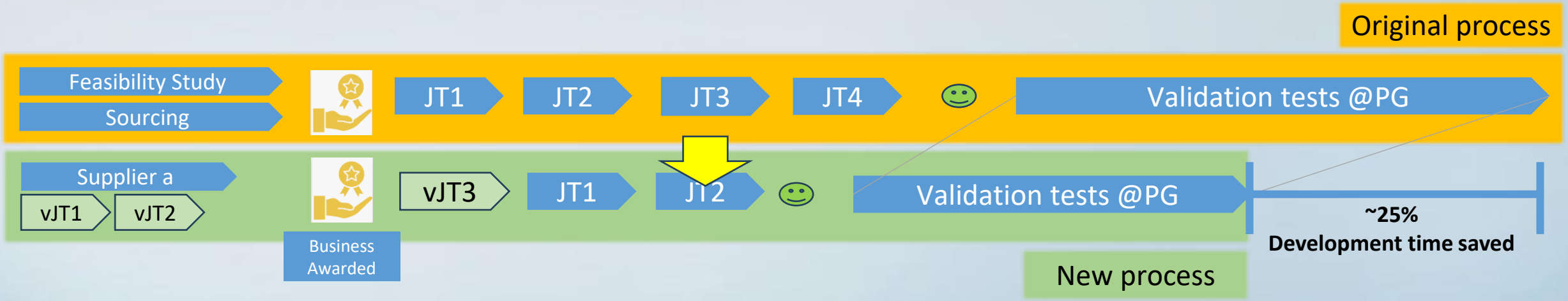

- More virtual models from system suppliers
- Open model sharing between OEMs and suppliers

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Thank you!

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Scan to stay in touch

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