Porsche Engineering

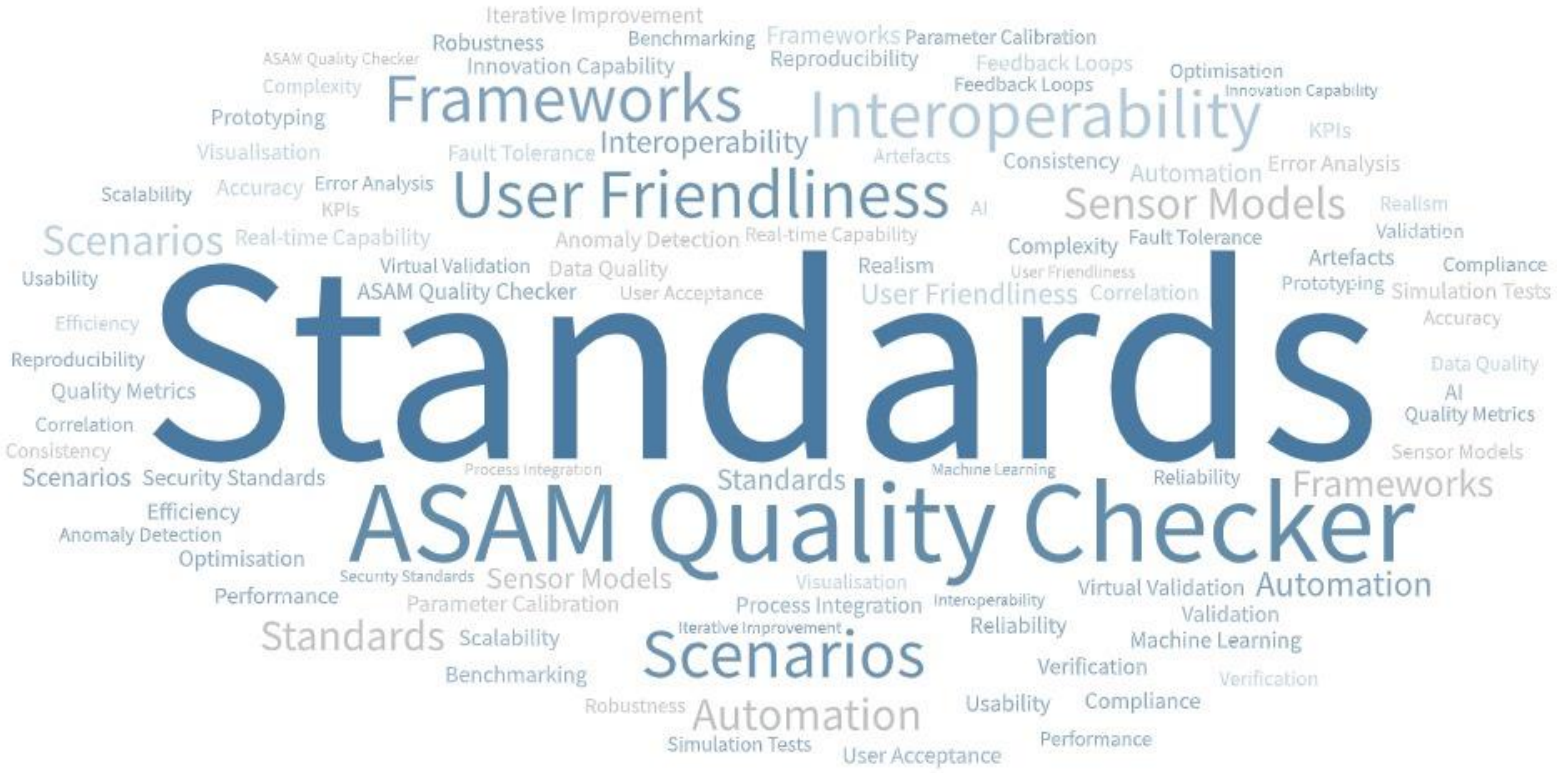
Industry's Requirements for Simulation Quality –
A Ride through the Virtual Reality of Real Automotive Needs

Tille Karoline Rupp - Head of Simulation
Porsche Engineering

10.09.2024 - Quantifying Simulation Quality (ASAM & HS Düsseldorf)

How to define Simulation Quality?

Let's ask...



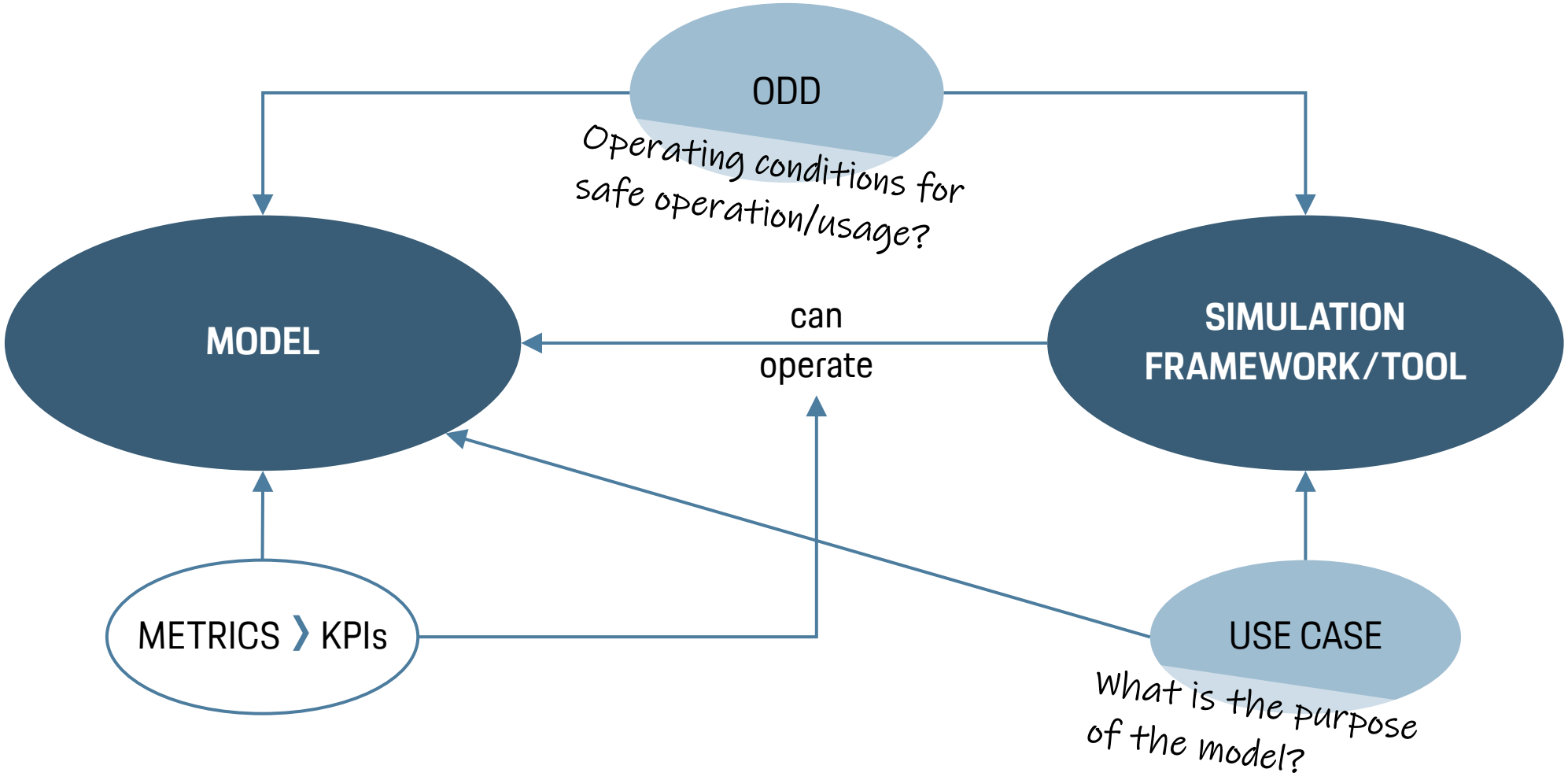
Model
Validation & Verification

Simulation Quality

Credibility of Simulation

How to define Simulation Quality?

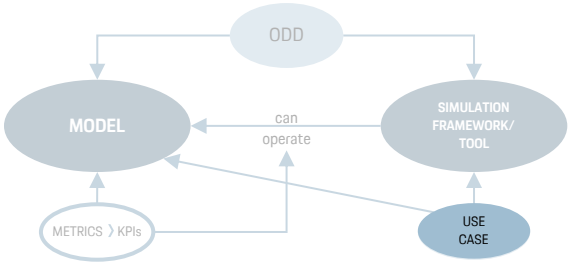
Let's dig deeper...



Simulation Quality

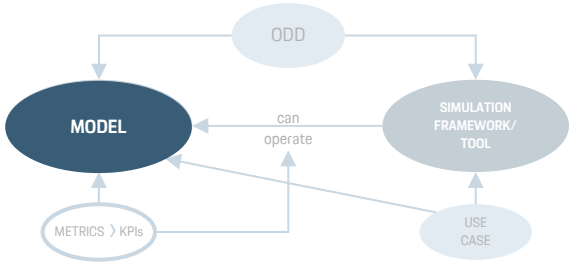
Basics & Definitions

Use Case



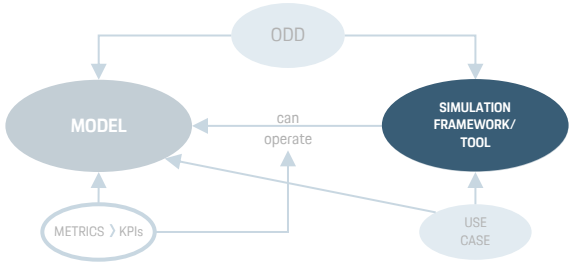
Defines the purpose for which a simulation tool or model shall be used. It matches a challenge with a potential solution.

Model



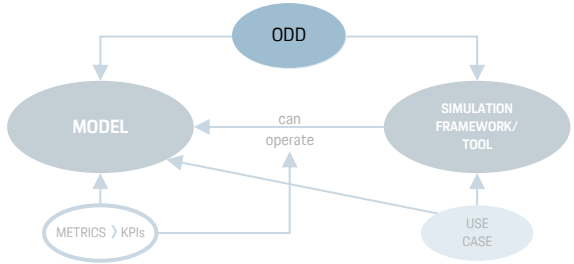
Reflects the (physical) properties of the subject it aims to represent.

Simulation Framework/Tool



Provides the means to operate models.

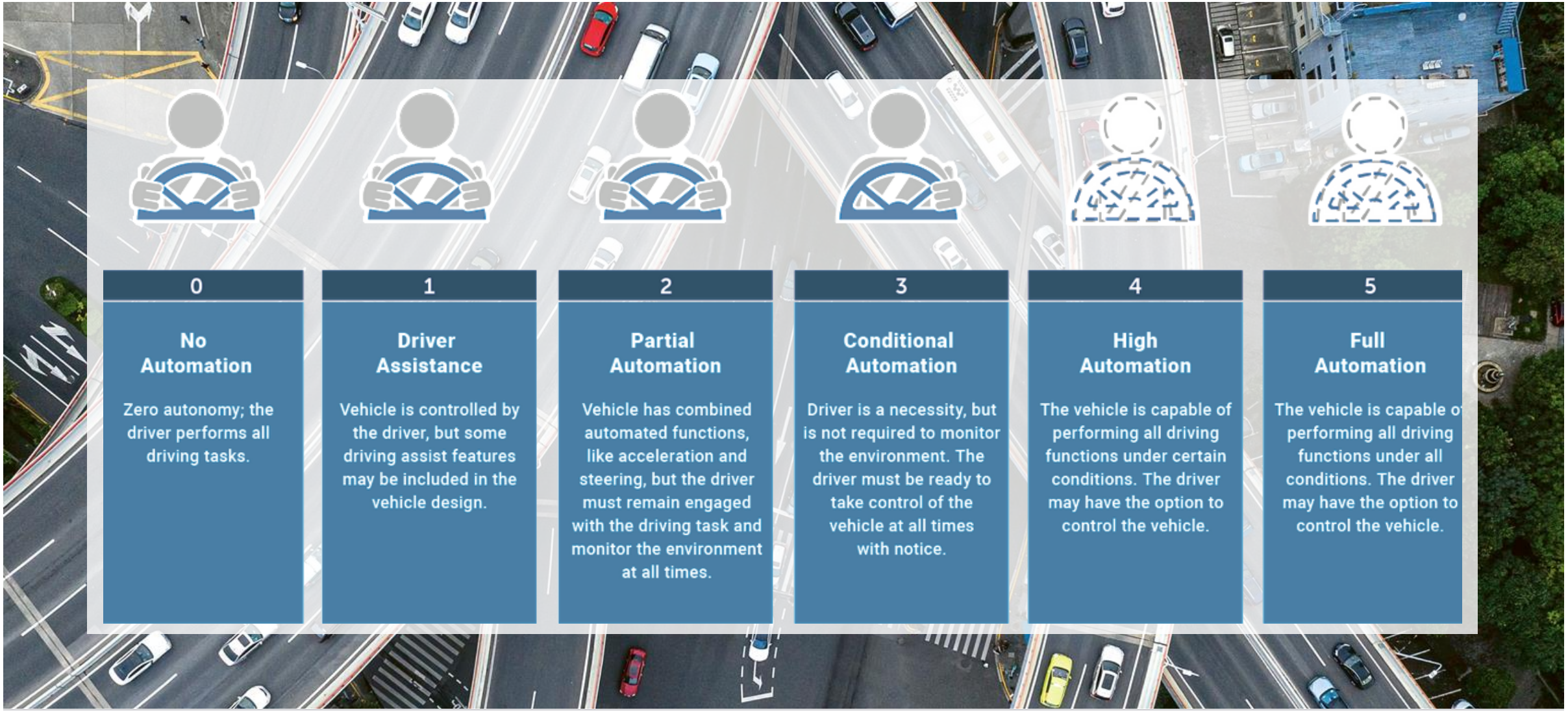
ODD (Operational Design Domain)



Indicates the circumstances or tasks under which models and tools may be used.

Verification and Validation for ADAS & AD

Introduction of Use Case



Distance- vs. Scenario-based Testing

Field Tests (distance-based testing):

- 6,6 billion kilometers need to be driven to statistically prove that highway pilot is at least as safe as a human driver [2]

uncritical situations

critical situations

[2] W. Wachenfeld and H. Winner, "Die Freigabe des autonomen Fahrens," in Autonomes Fahren, M. Maurer, J. C. Gerdes et al., Eds. Berlin, Heidelberg: Springer Berlin Heidelberg, 2015, pp. 439–464.

Distance- vs. Scenario-based Testing

Field Tests (distance-based testing):

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(Re)Simulation (scenario-based testing):

- Focus on critical situations [3-5]
- Need for scenarios that are
  - representative for reality [2,5] → *based on real data*
  - provide sufficient coverage of scenario space [2,6,7] → *variation of scenarios*

uncritical situations

critical situations

[2] W. Wachenfeld and H. Winner, "Die Freigabe des autonomen Fahrens," in Autonomes Fahren, M. Maurer, J. C. Gerdes et al., Eds. Berlin, Heidelberg: Springer Berlin Heidelberg, 2015, pp. 439–464.
[3] C. S. Sippl, "Identification of relevant traffic situations for scenario-based development of automated driving functions," Ph.D. dissertation, Friedrich-Alexander-Universit¨at Erlangen-N¨urnberg, Sep. 2020.
[4] F. Schuldt, "Ein Beitrag f¨ur den methodischen Test von automatisierten Fahrfunktionen mit Hilfe von virtuellen Umgebungen," Ph.D. dissertation, Technische Universit¨at Carolo-Wilhelmina zu Braunschweig, Braunschweig, Oct. 2016.
[5] R. Pfeffer, "Szenariobasierte simulationsgest¨utzte funktionale Absicherung hochautomatisierter Fahrfunktionen durch Nutzung von Realdaten," Ph.D. dissertation, Karlsruher Institut f¨ur Technologie (KIT), Karlsruhe, Aug. 2020.
[6] F. Montanari, C. Stadler et al., "Maneuver-based Resimulation of Driving Scenarios based on Real Driving Data," in 2021 IEEE Intelligent Vehicles Symposium (IV). Nagoya, Japan: IEEE, Jul. 2021, pp. 1124–1131.
[7] F. Montanari, R. German, and A. Djanatliev, "Pattern Recognition for Driving Scenario Detection in Real Driving Data," in 2020 IEEE Intelligent Vehicles Symposium (IV). Las Vegas, USA: IEEE, Oct. 2020, pp. 590–597.

Synthetic – Hybrid – Physical V&V

From Virtual to Real Testing

Synthetic and Hybrid V&V

Overview

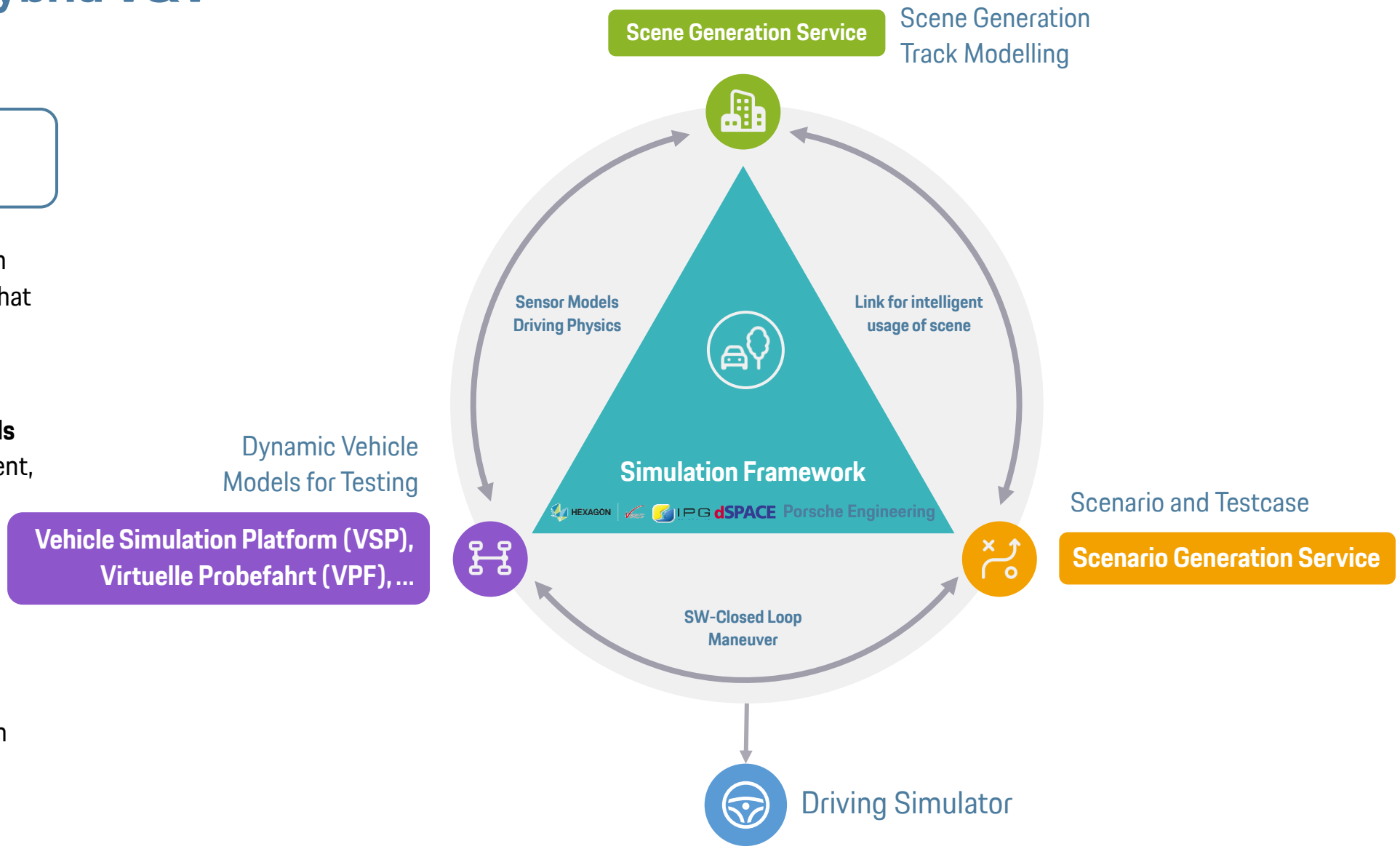
Value Proposition

Porsche Engineering Simulation Team is a **competence center** that aims to **minimize the need for physical testing in real cars**

We provide **know-how and tools for virtual ADAS/AD** development, testing and verification and validation (V&V)

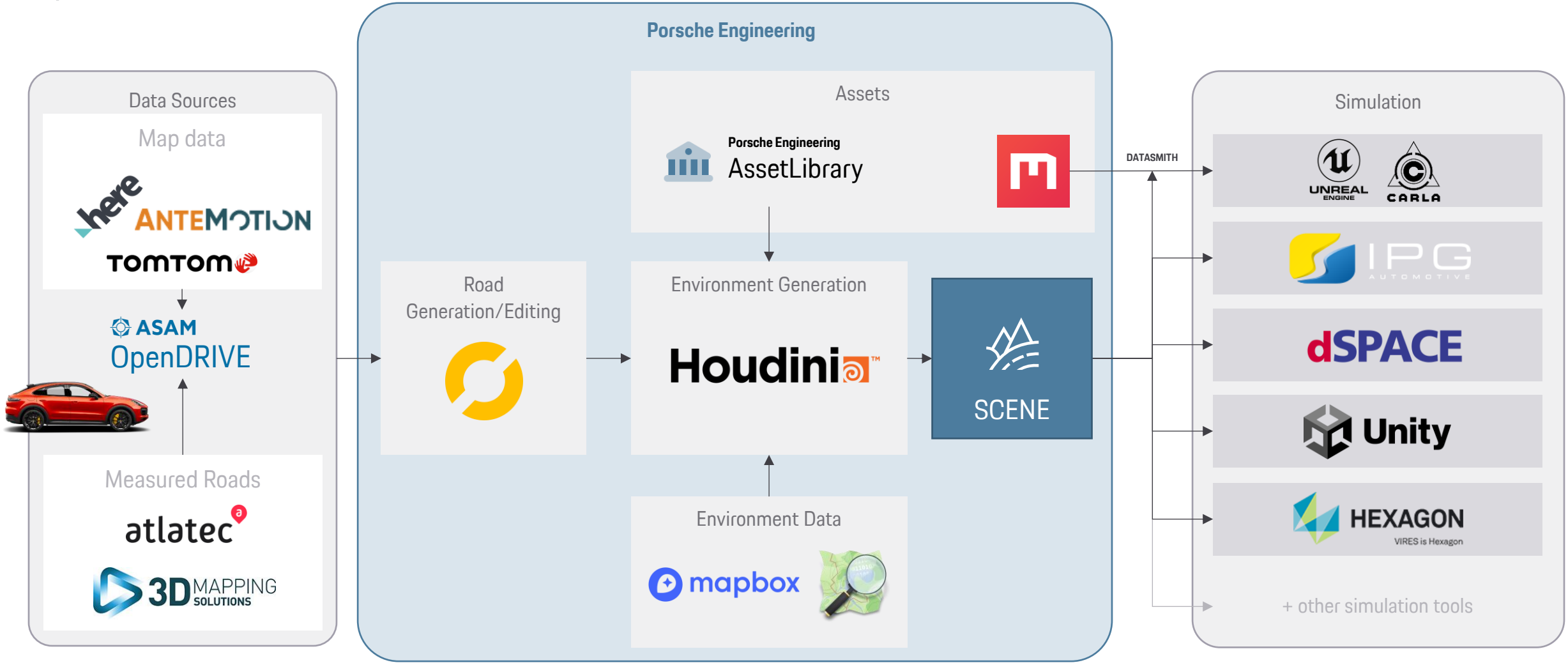
Customer specific simulation services from **vehicle, track/ scene and scenario modelling**

Enabling of **SiL & HiL** test bench setup



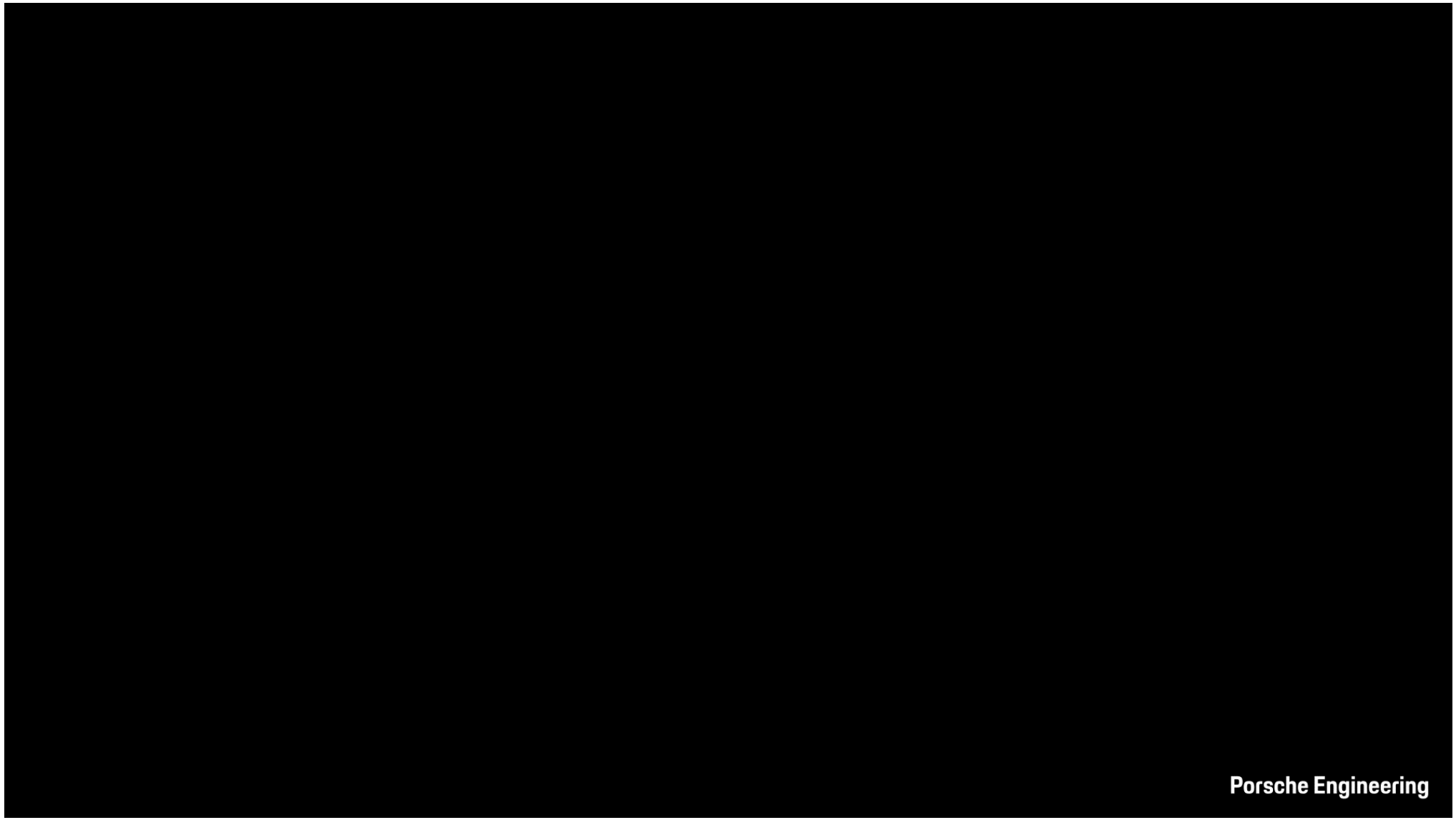
Scene Generation Pipeline

Input Data



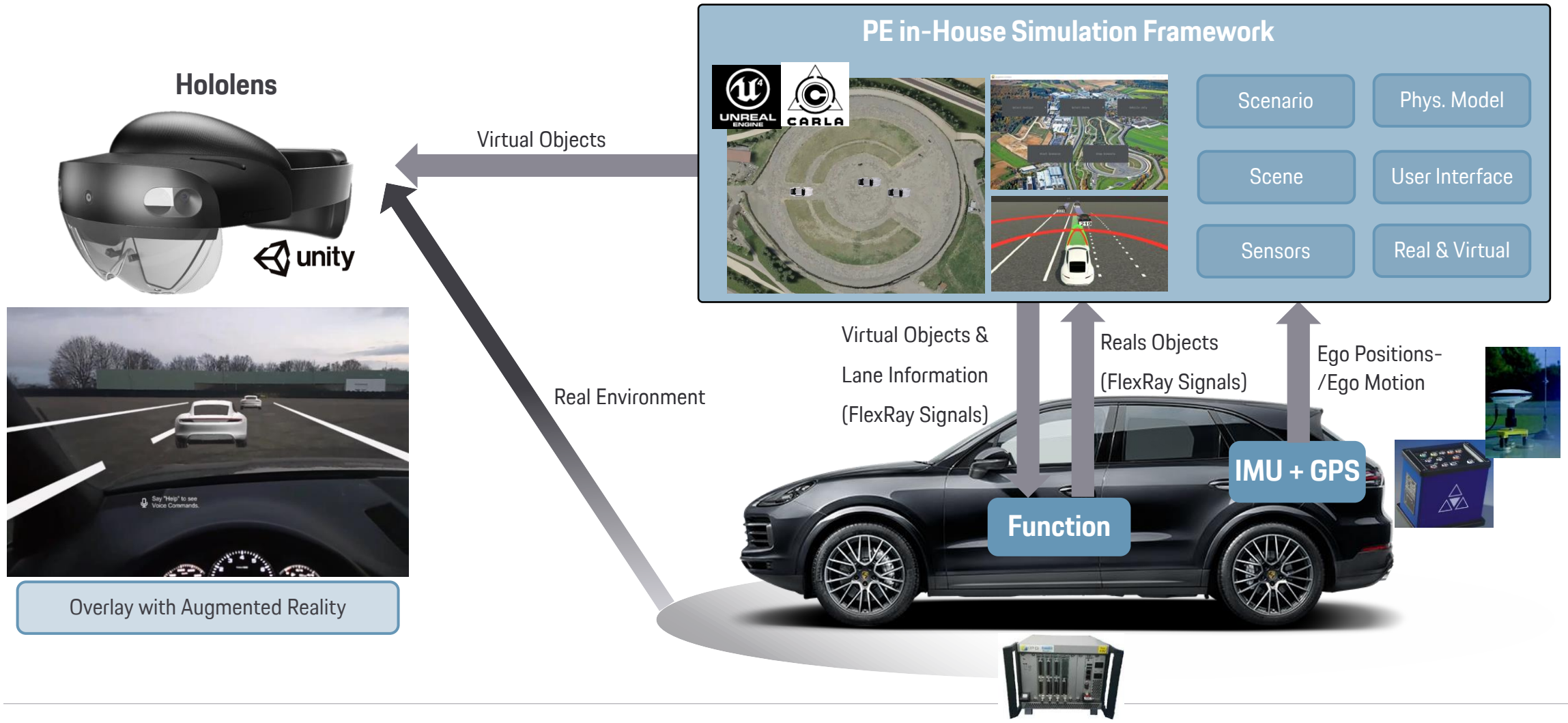
Big Data Loop

Reference SiL



Mixed Reality Demonstrator

Reference ViL



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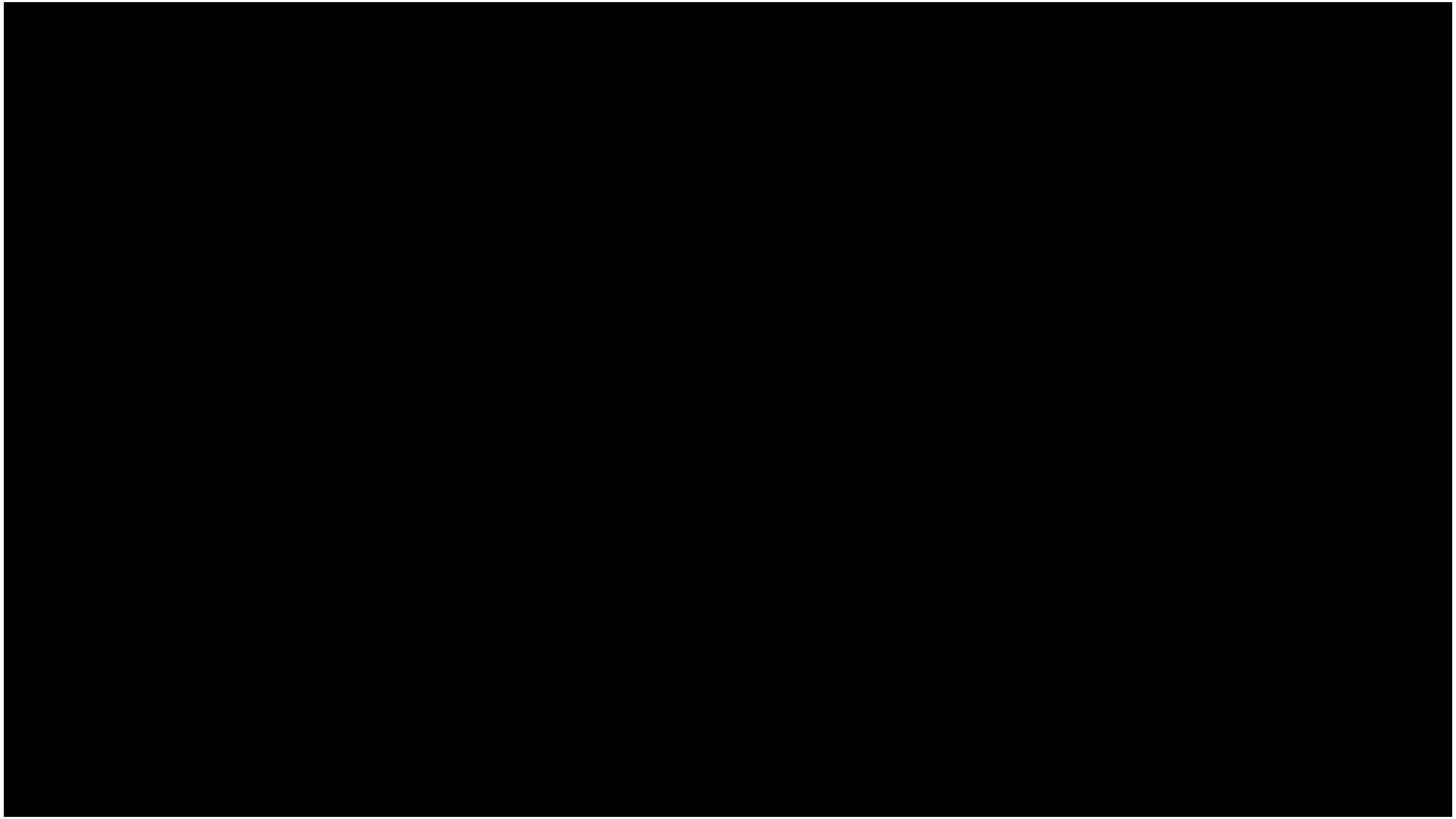
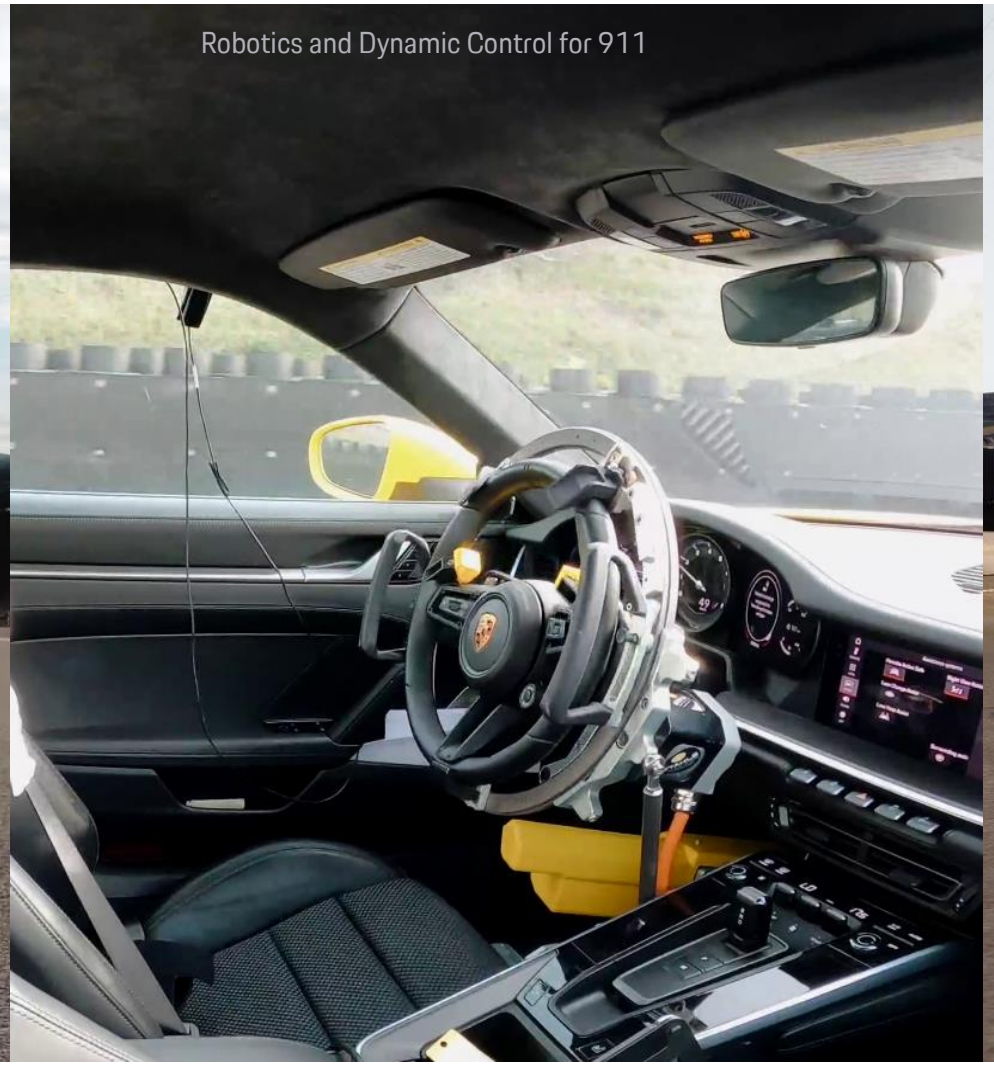


Automated Testing in Cars

Reference – Simulation-supported Development



Automated Testing in Cars

Reference – Simulation-supported Development

- Automated vehicles do tests on proving grounds, e.g. endurance, high load and ADAS tests
- Robot Systems
- Trajectory planner & driving dynamic controller
- First test lap on Weissach proving ground
- **Closed-loop Simulation** with dynamic controller
- Vehicle dynamic model

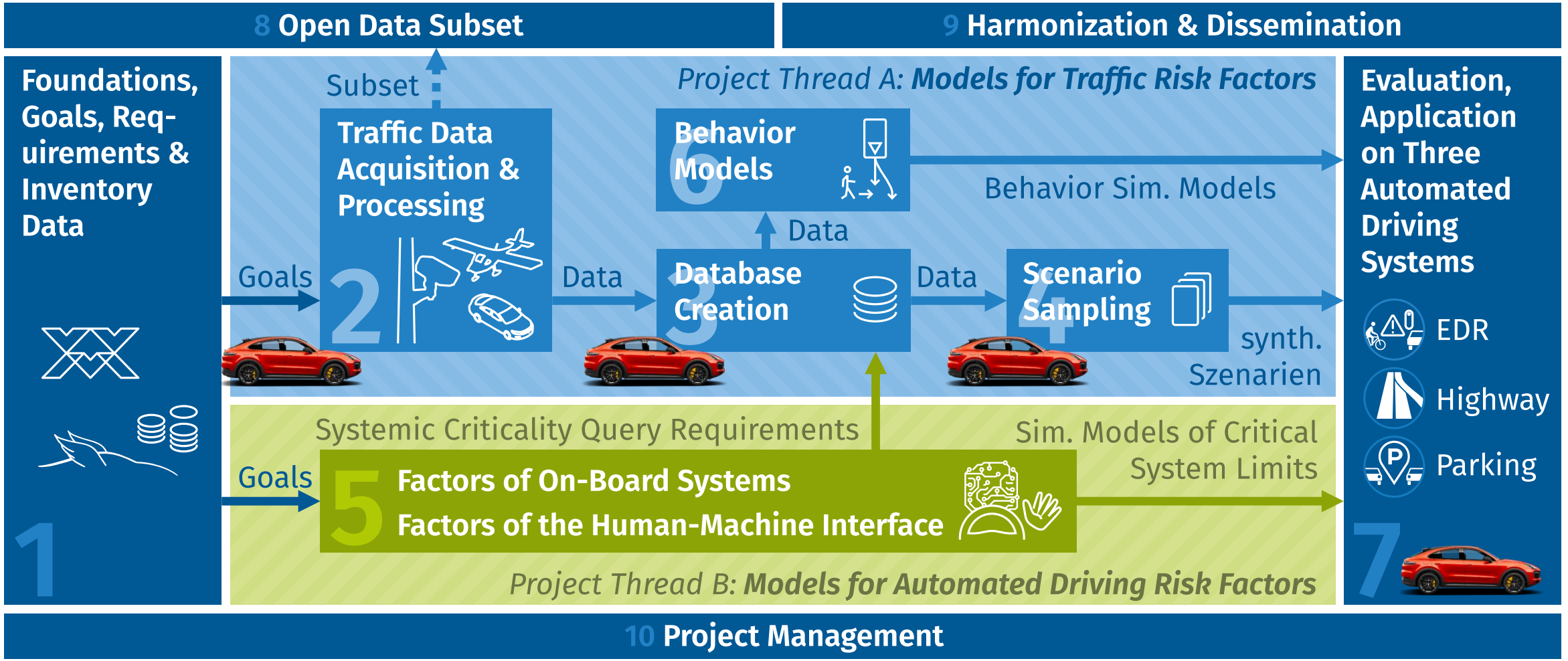
Research Project AVEAS – Re-Simulation

Absicherungsrelevante **V**erkehrssituationen **e**rheben, **a**nalysieren und **s**imulieren

AVEAS

Porsche Engineering
driving technologies

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag



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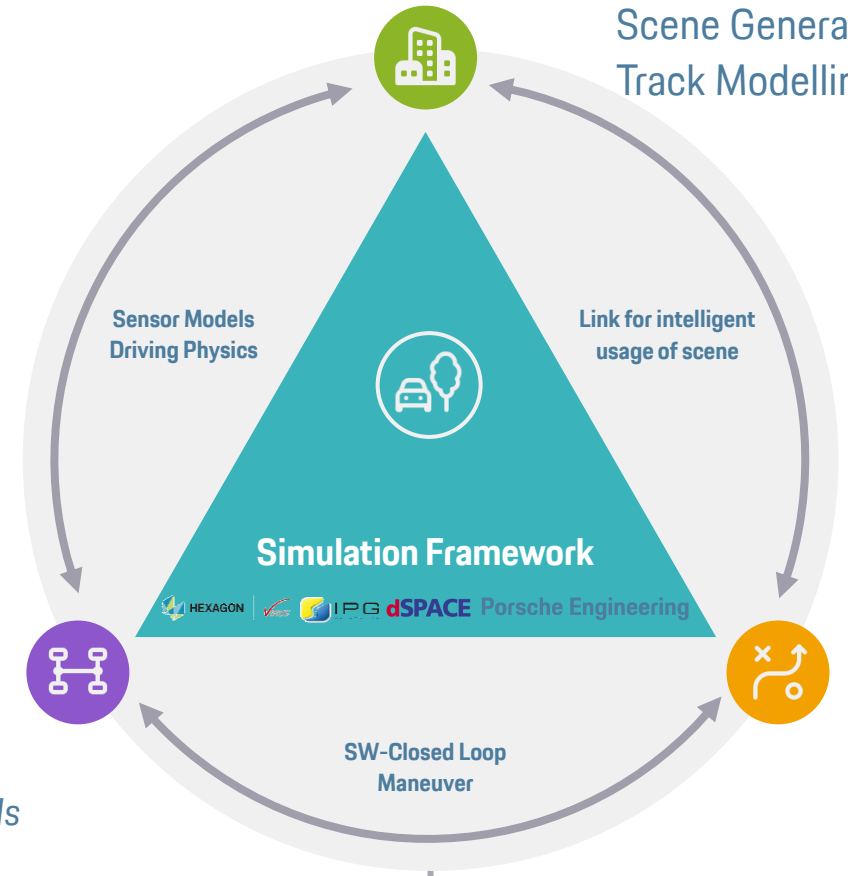
Synthetic and Hybrid V&V

Overview



ASAM *Quality Checker*

Driveablity ❭ Driving Simulator

XODR Comparison

Dynamic Vehicle
Models for Testing

Vehicle Simulation Platform (VSP), Virtuelle Probefahrt (VPF), ...

Detailed Measurement Data for KPIs

Scenario and Testcase

Scenario Generation Service

Re-Simulation ❭ AVEAS

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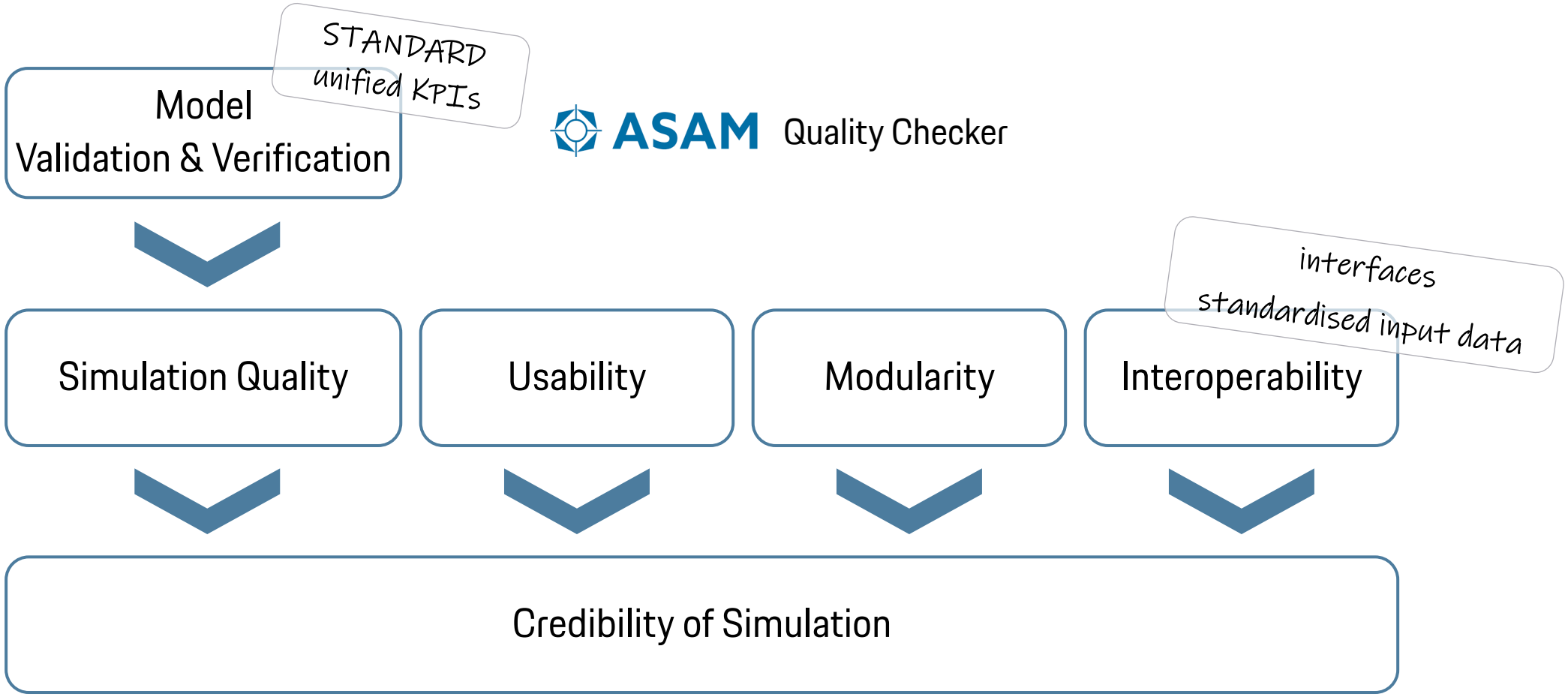
How about that? Let's discuss...



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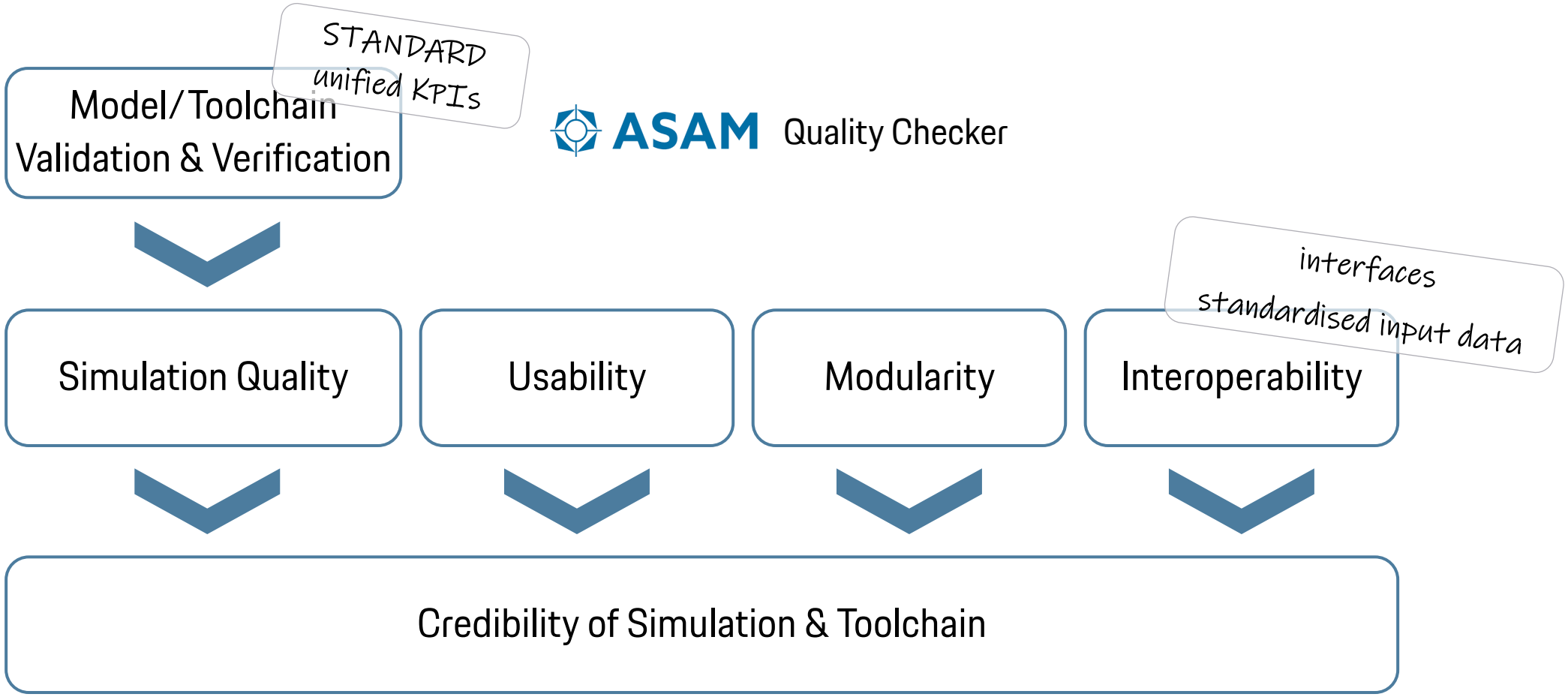

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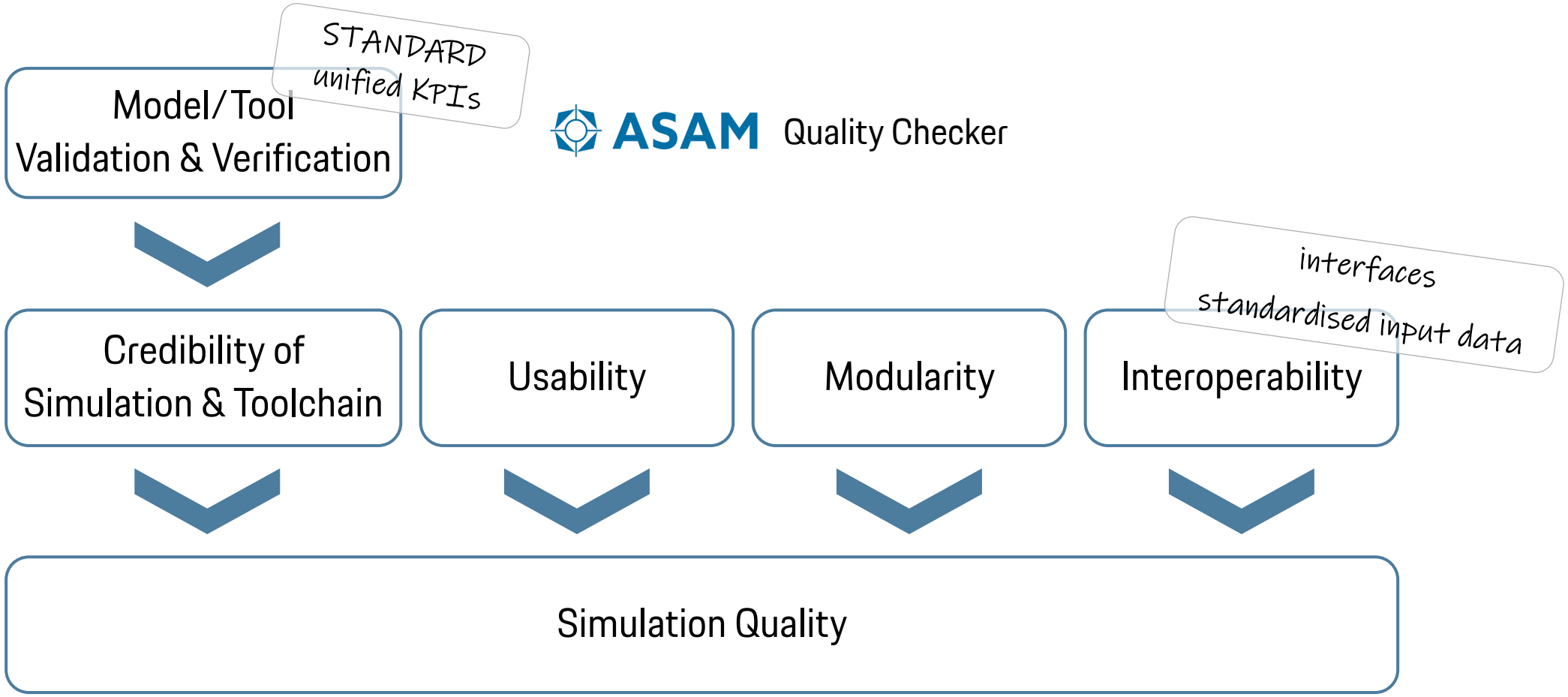

How to define Simulation Quality?

How about that? Let's discuss...

STANDARD
unified KPIs

Model/Tool
Validation & Verification

ASAM Quality Checker

interfaces
standardised input data

Credibility of
Simulation & Toolchain

Usability

Modularity

Interoperability

Simulation Quality

Simulation Quality?| Let's talk!

1. Q&A

2. Contact

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3. Porsche Engineering Magazine

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