Key Technology: Data-Driven Software-Hardware Co-Design

Beyond the Engine: Unleashing the Potential of Automotive Software

Dr. Jost Bernasch, CEO Virtual Vehicle

7. November 2024

virtual vehicle

www.virtual-vehicle.at

Delays in vehicle projects … a frequent topic

AUTOMOTIVE

General Motors facing delays, software glitches in early days of EV transition

By Dave Kunz

Sour 7595/

Home / Today's Market

Rivian Delays Vehicle Deliveries Due to Software Issues

Rivian also has two key events coming up

By Eddie Pan, InvestorPlace Financial News Writer Feb 9, 2024, 11:13 am EDT

- **Rivian (RIVN)** has paused deliveries in Canada, according to *L Canada.*
- The company confirmed that the pause was enacted in order to fi issue.
- RIVN stock is down by over 20% this year.

7 A.I. Stocks With "Millionaire Maker" Potential in 2024

Source: https://investorplace.com/2024/02/rivian-delays-vehicle-deliveries-due-to-software-issues-rivn-stock/

Automotive News Europe

A CRAIN FAMILY BRAND

Automotive News

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Home › Cars & Concepts

July 20, 2023 03:22 PM

Volvo EX90 launch delayed over software integration

Production of Volvo's flagship electric crossover is pushed 'five or si months.'

URVAKSH KARKARIA

DELAYED

project

dollars over a decade

vehicle effort, internally nicknamed Project Titan, was marred by layoffs, strategic changes, and repeated delays

By William Gavin Published February 27, 2024

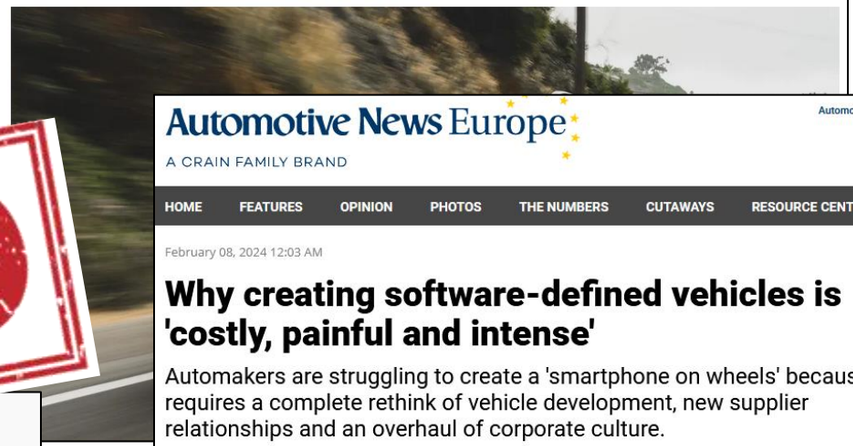
Source: https://qz.com/apple-ev-electric-car-project-titan-canceled-1851291112

Transportation

Layoffs at VW's Cariad further delay software launch in Porsche, Audi models

Rebecca Bellan / 4:12 PM PDT • October 30, 2023

Comment



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HOME FEATURES OPINION PHOTOS THE NUMBERS CUTAWAYS RESOURCE CENTER

February 08, 2024 12:03 AM

Why creating software-defined vehicles is 'costly, painful and intense'

Automakers are struggling to create a 'smartphone on wheels' because it requires a complete rethink of vehicle development, new supplier relationships and an overhaul of corporate culture.

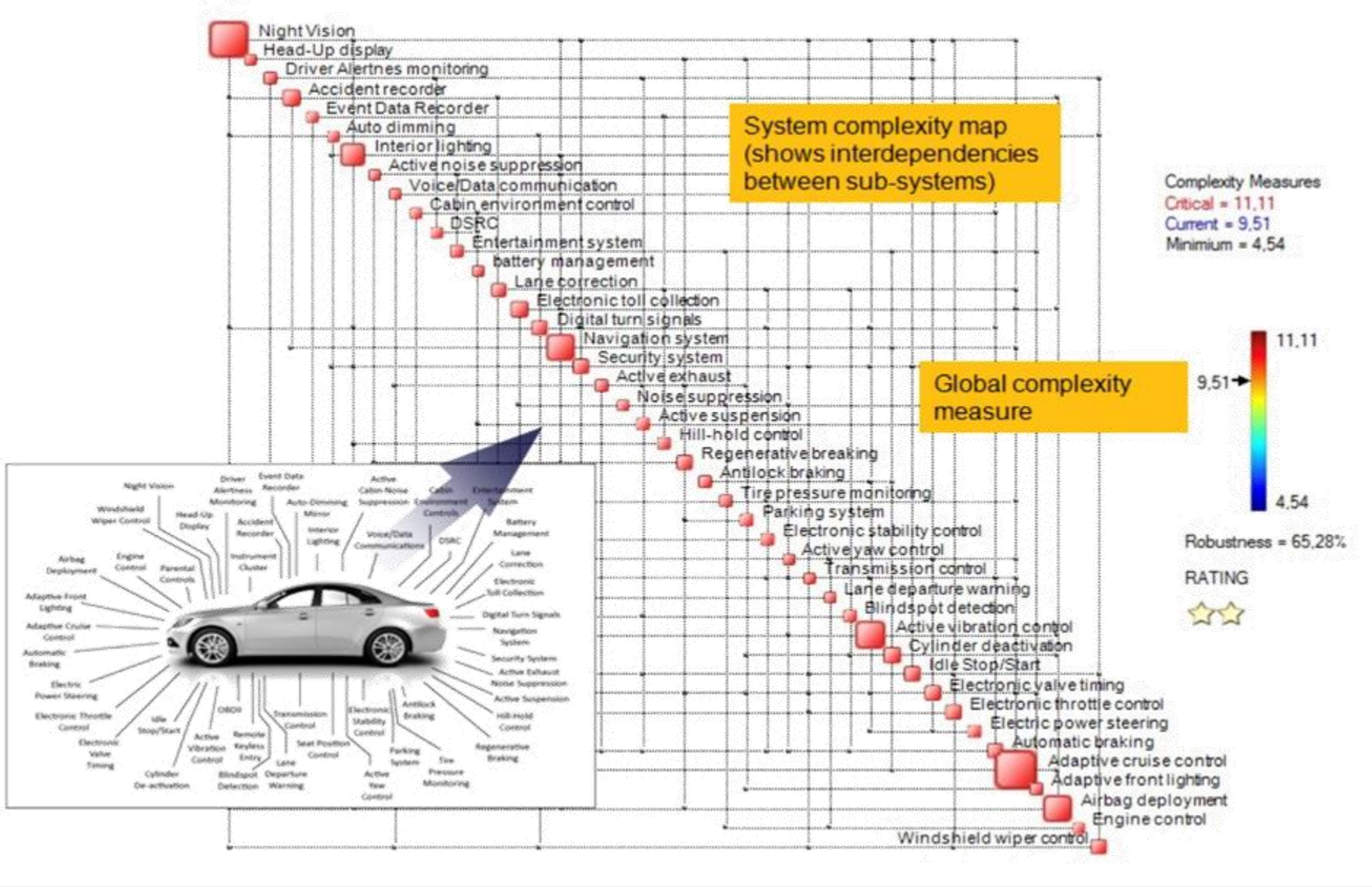
NICK GIBBS

TWEET SHARE SHARE EMAIL

Source: https://europe.autonews.com/automakers/automakers-struggle-create-software-defined-vehicles

Complexity of systems

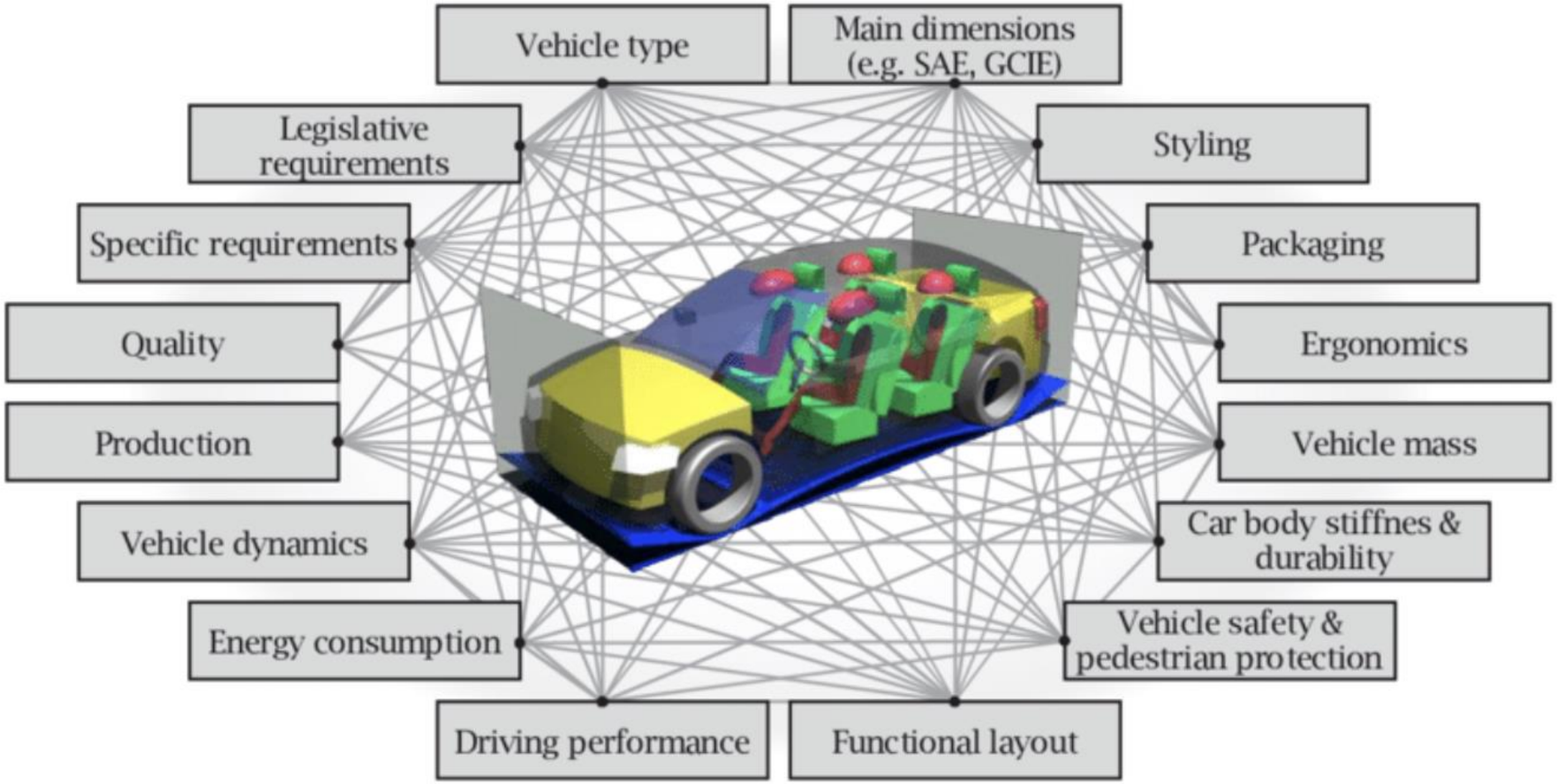
- Hardware and software with increasing complexity
- Development & operation of vehicles (e.g. software updates)
- 1 ECU ➔1 vehicle problem (e.g. engine-, transmission-, suspension-, airbag-, HVAC-control)
- Many problems → many ECUs required



Source: ontonixqcm.blog/car-electronics-how-much-more-complexity-can-we-handle/

Vehicle Requirements

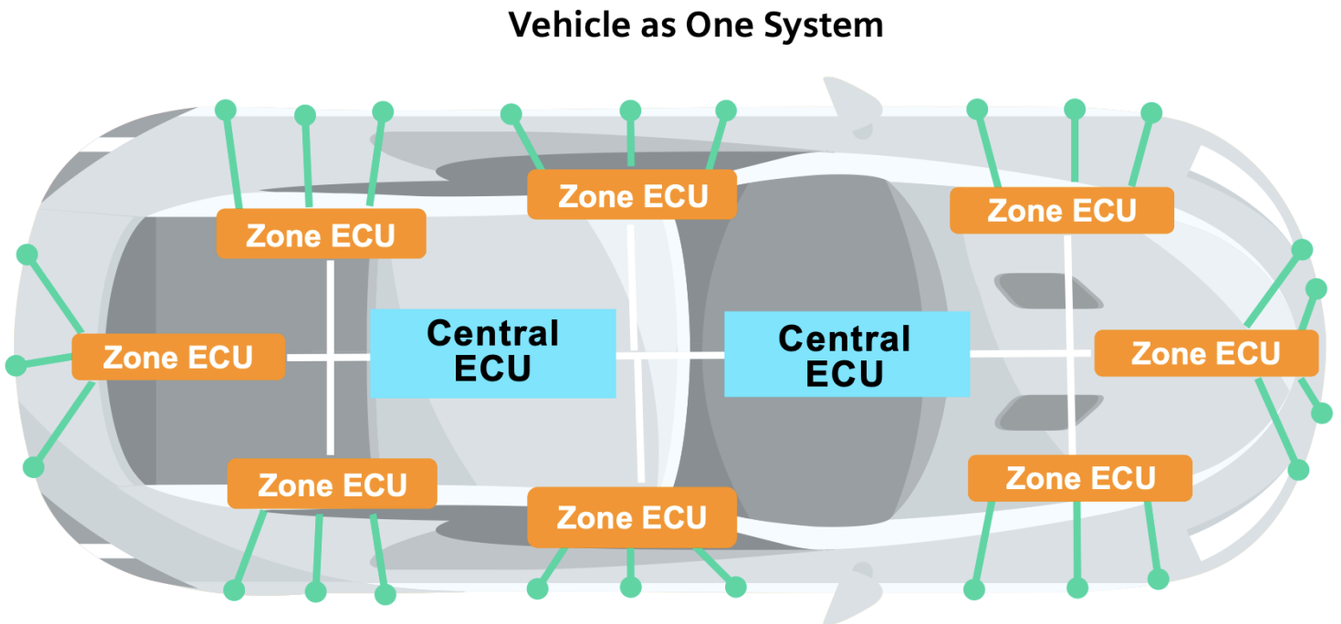
- A lot of vehicle functions
- Battery – Safety, Capacity, Weight, Structure
- Energy Efficiency
- Worldwide legal requirements
- Virtual Validation is coming



High-performance E/E platform

Key architectural directions

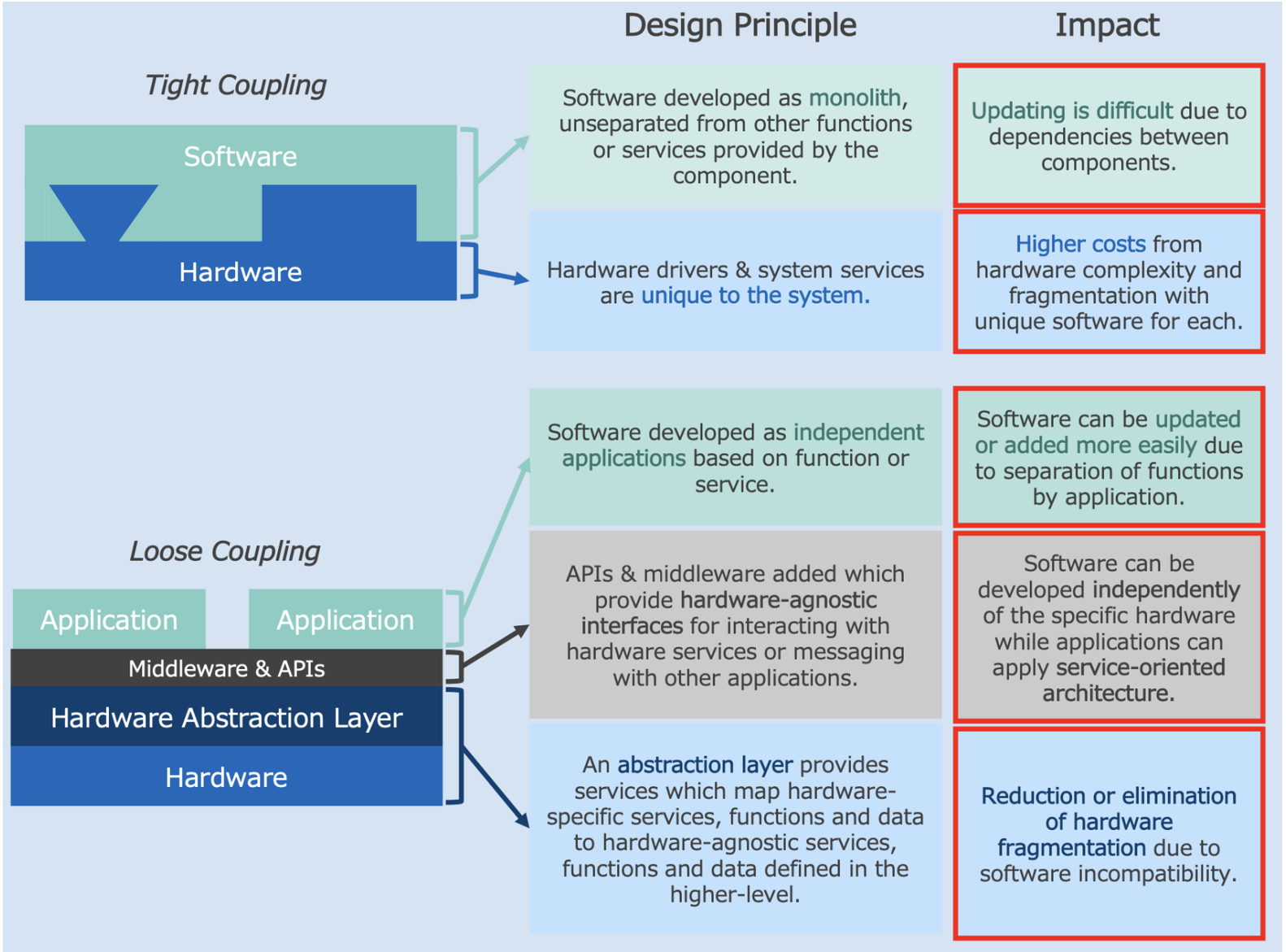
- Centralized computer system
- Vehicle zonal I/O concentrators
- Highly scalable and modular E/E hardware structure
- Software centric with a Service Oriented Architecture
- Real-time, deterministic Ethernet AVB/TSN network
- Must support software configuration and Agile Continuous Integration & Test development flow



Source: Siemens / BCG

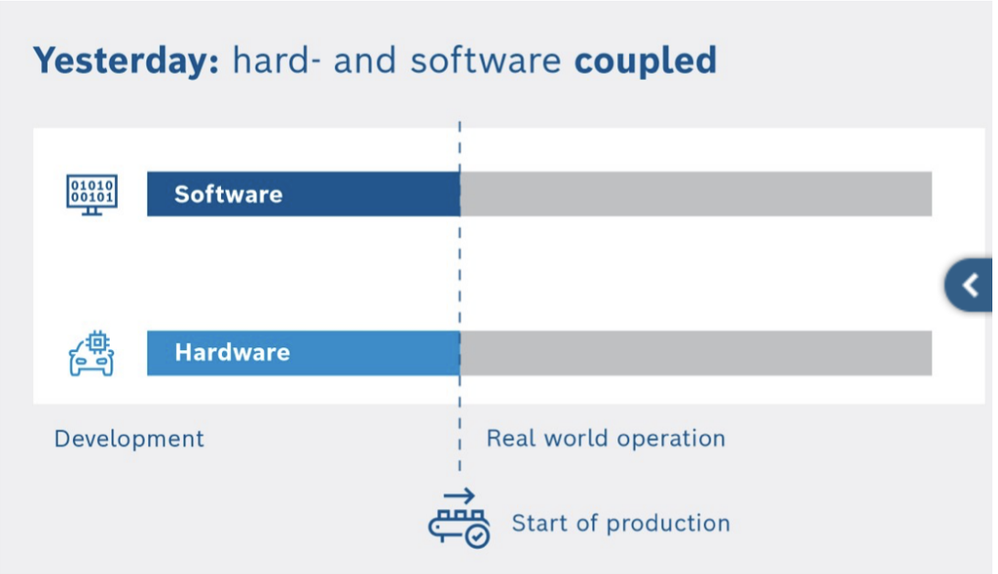
Huge demand for scalable, versatile software and hardware platforms

Future hardware-software co-design



Source: SBD Automotive

Future hardware-software co-design

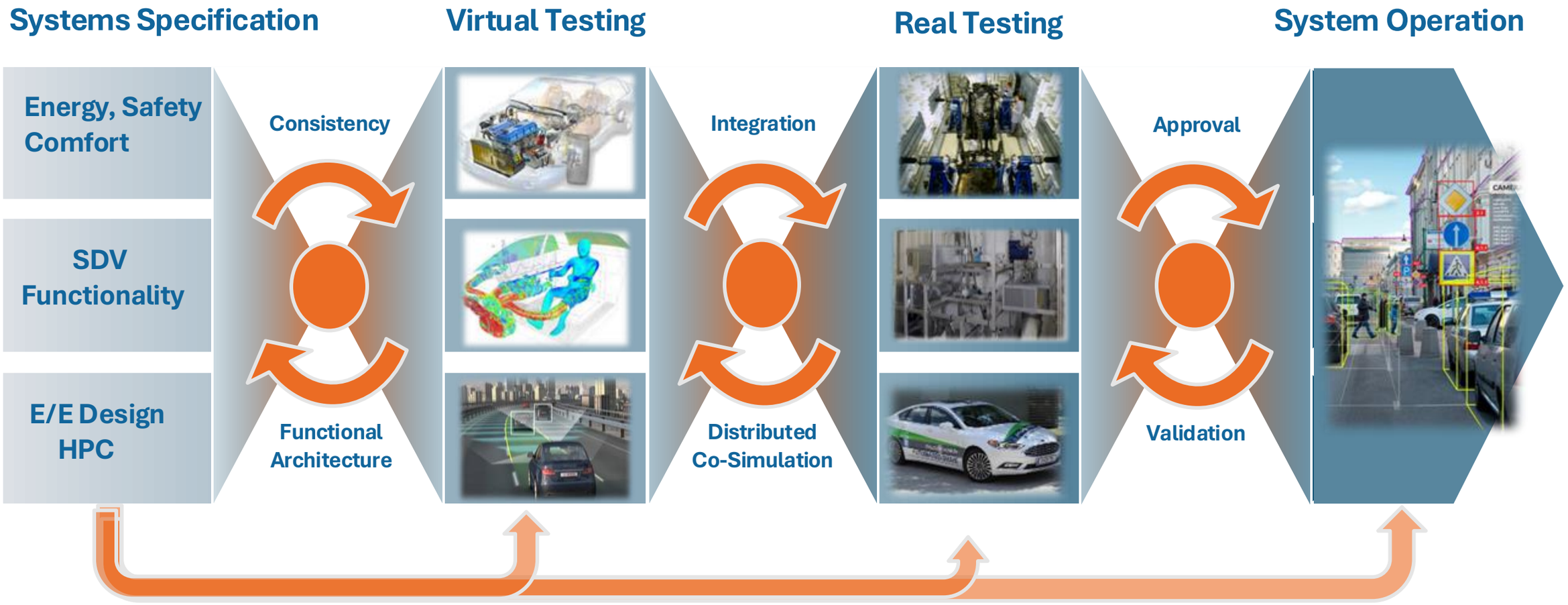


The separation of hardware and software

Source: Bosch-Mobility

How to handle the different cycles for hardware and software?

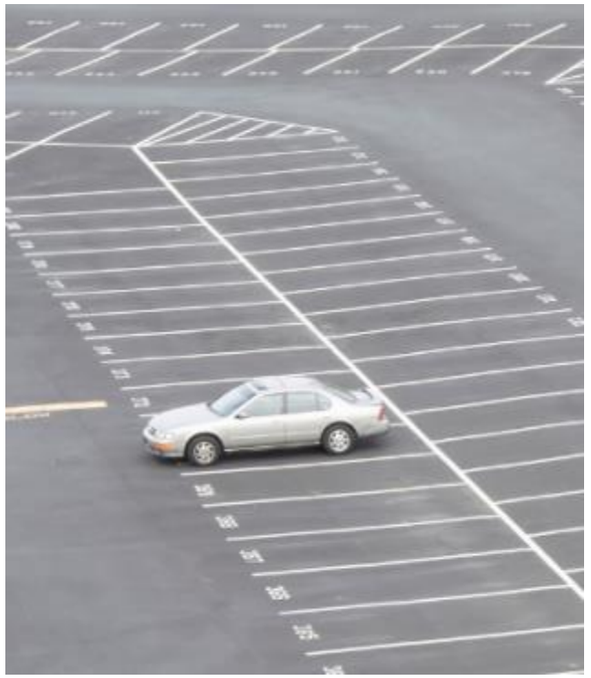
USP: Multi-domain system: Vehicle Domains, SDV, HPC

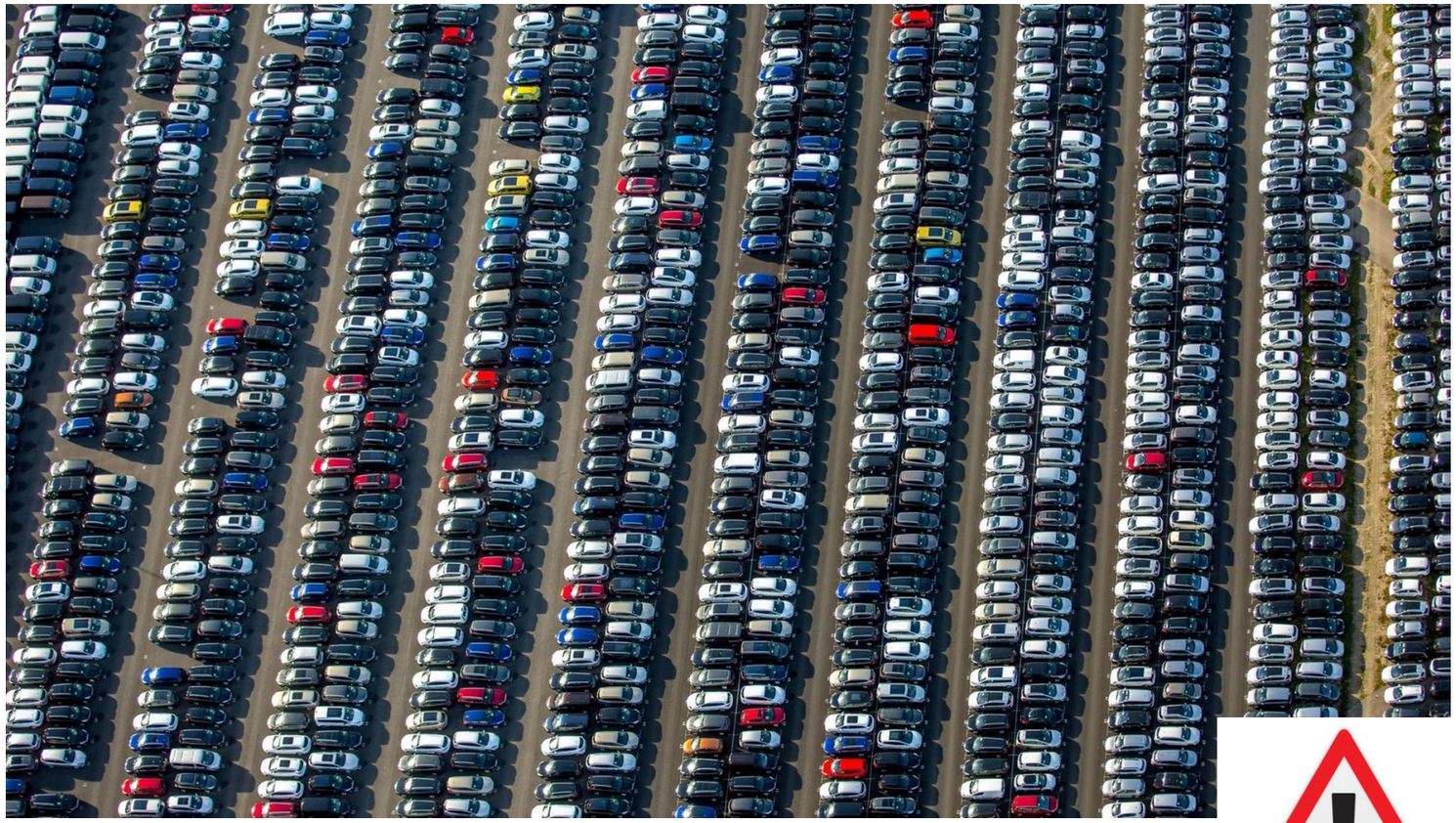


Continuous Data Provision and Utilization - 3 x times

Connecting SW-intensive systems, vehicle domains, HPC HW integration and operation

Why is data-driven relevant?





Software: version 3.1.2 (7 Nov 2025)
Additional customer settings: ADAS kit, sport kit
Hardware platform: generation 3 (2 Feb 2025)

Millions of vehicles
→ countless SW, HW and data statuses

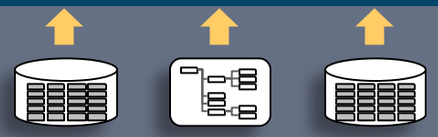
How to find mutual influence?
Where to fix a bug?

Key Elements for Future Engineering – Aim of Data Context Hub

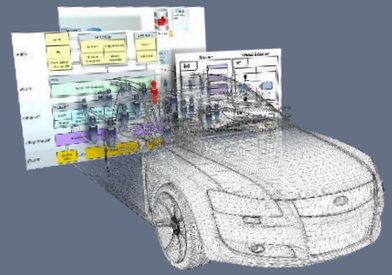
Future Competitiveness and Process Performance

Lifecycle Data Hub / Decision

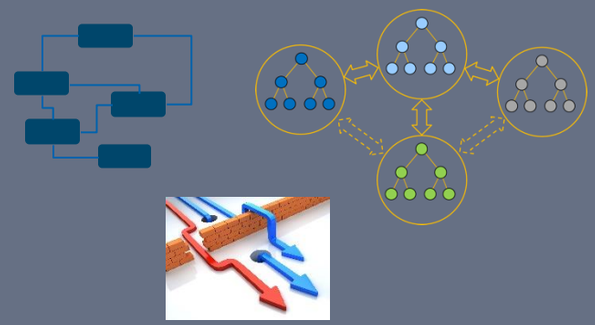
Data Exploration & Context



Automated Simulation & Validation



Systems Engineering and Function-based Development



Digital Thread - availability, traceability and semantic context of heterogeneous data and information

Data Accessibility and Synchronisation

Connectivity, Context and Semantics of Data

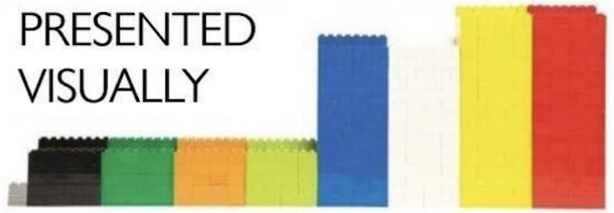
DATA

EXPLAINED
WITH A STORY

SORTED

ARRANGED

PRESENTED
VISUALLY



Data Context Hub

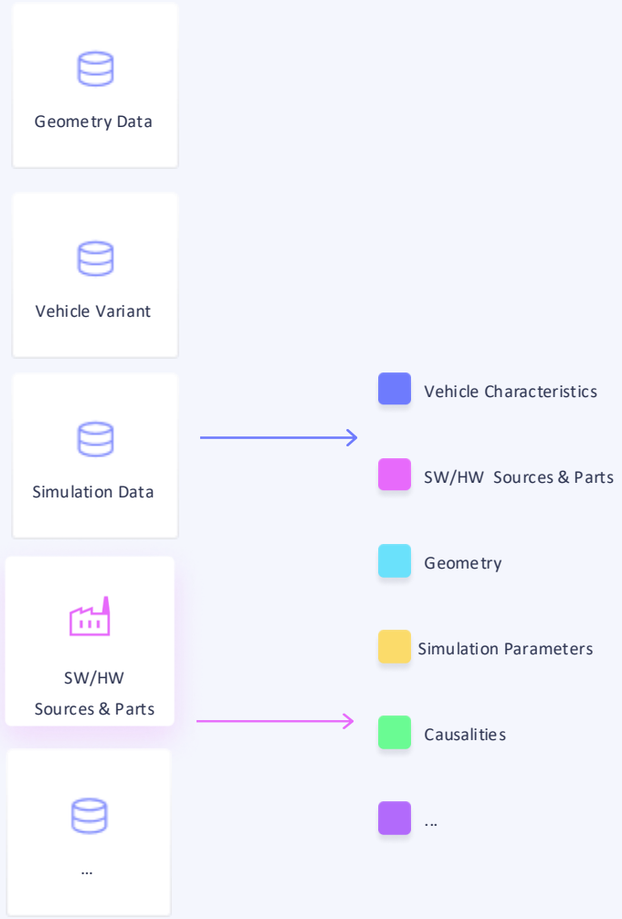
Efficient Data Management

Break Down Silos, Unlock Insights, Make Informed Decisions

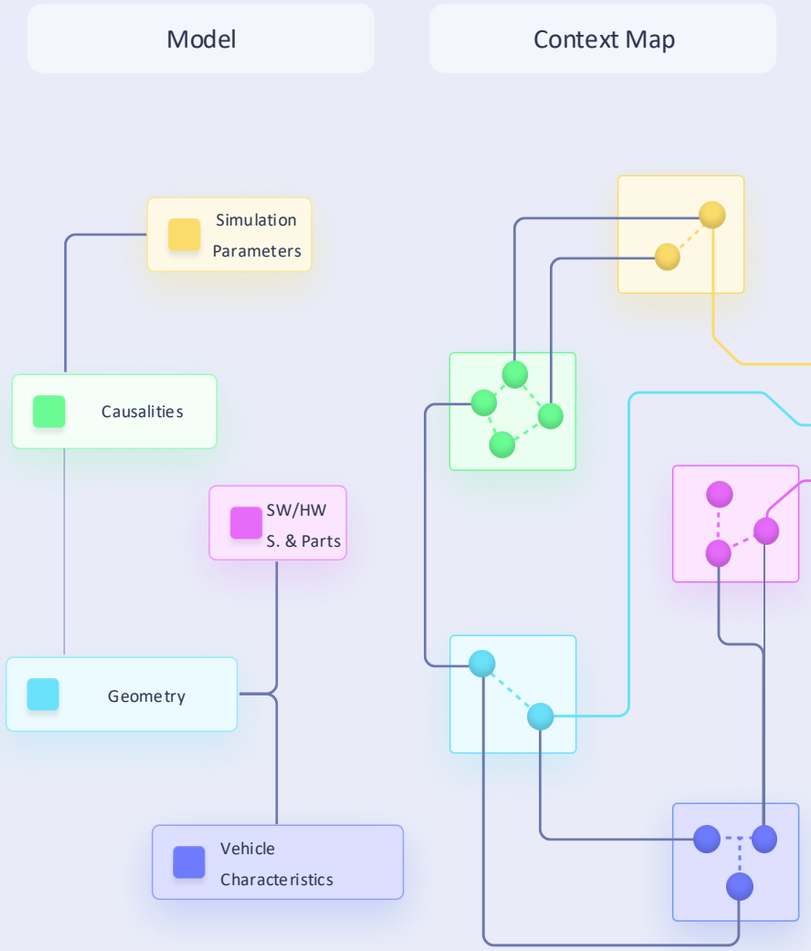
Data Context Hub

Basic Concept ICD – Intake, Context, Delivery

Intake



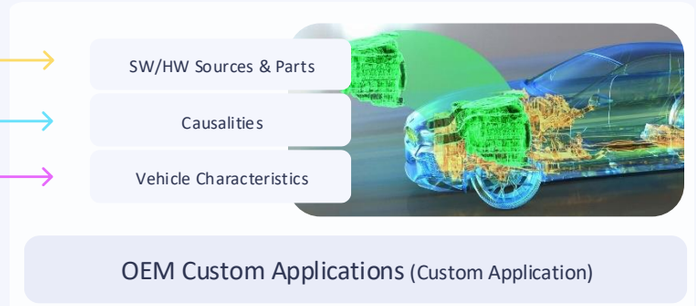
Context



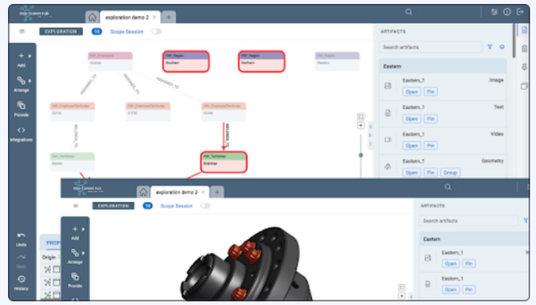
Delivery

Solution – Virtual Buildability

DCH empowered the client to develop a unified frontend application. This application facilitates the assessment of a vehicle's virtual buildability by centralizing access to all relevant information. With its high performance and minimal latency, it ensures swift decision-making and efficient feedback loops.

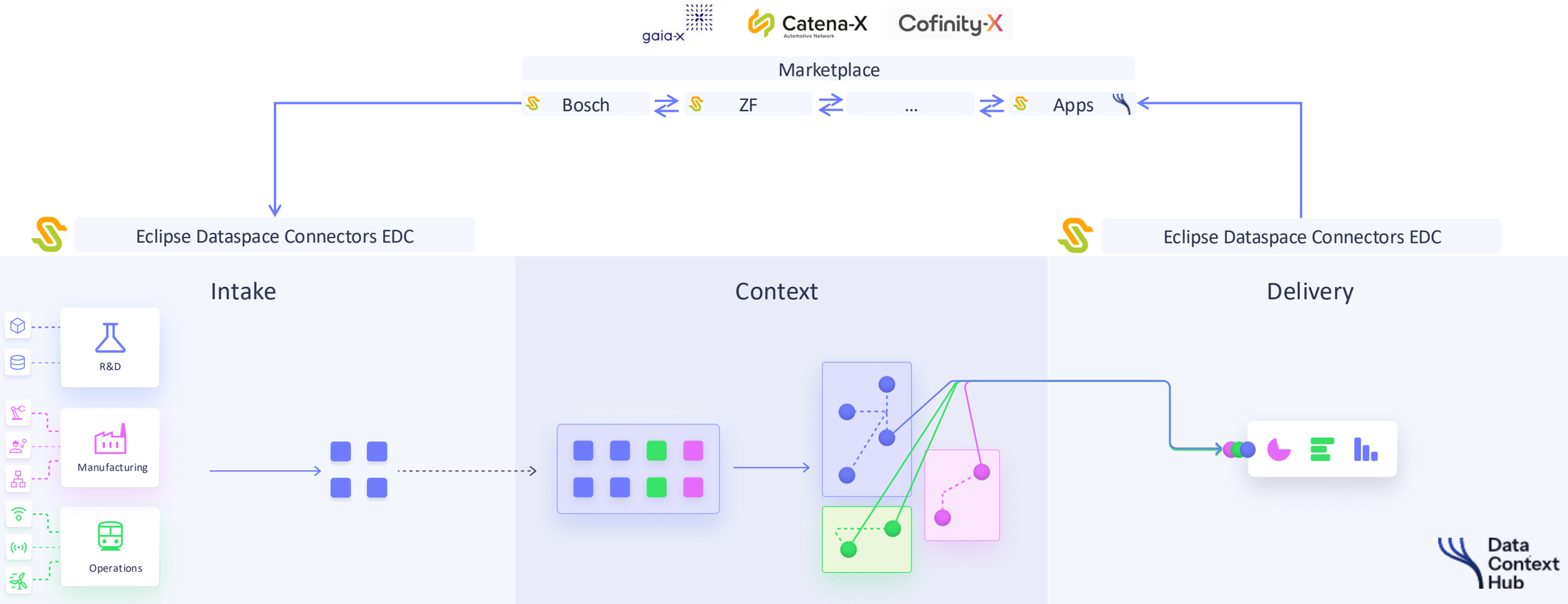


Solution – Engineering data exploration



Future potential –
Open Data Spaces Data Provider

DCH, as the **technology for implementing a data provider** in an open data space, offers datasets in standardized and interoperable formats, ensuring they're accompanied by precise metadata and documentation. Complying with technical protocols, DCH ensures secure and regulated data transmission while continually updating its data for relevance. Integration with the open data space infrastructure, such as specific APIs or platforms, facilitates seamless accessibility and exchange by other participants.



Data-driven hardware-software co-design at Virtual Vehicle Research

Examples

virtual vehicle

From the initial spark to a global player

2002-2007
Foundation

Spin-off from TU Graz & Styrian industry: **New research center for virtual vehicle development**

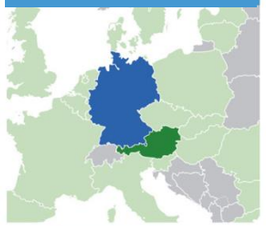
2008-2017
Structure & Growth

R&D sustainable mobility
New pillars
- EU projects
- Contract research

2018-2026 / 2027-2034
Long-term stability & international success

Strategic partners road and rail
Additional domains: robotics, energy, health-tech, defense
Putting innovations from 300+ experts into practice

AUSTRIA & GERMANY



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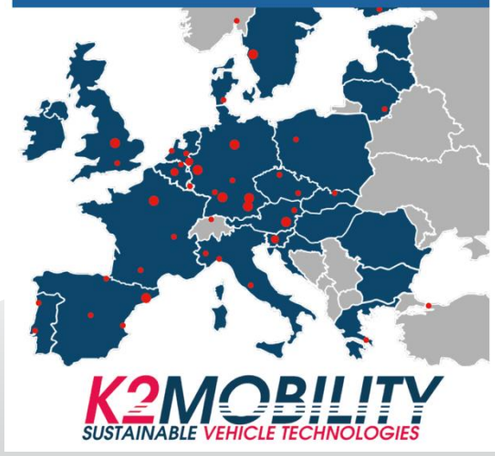
EUROPA+



WORLD-WIDE NETWORK

virtual vehicle

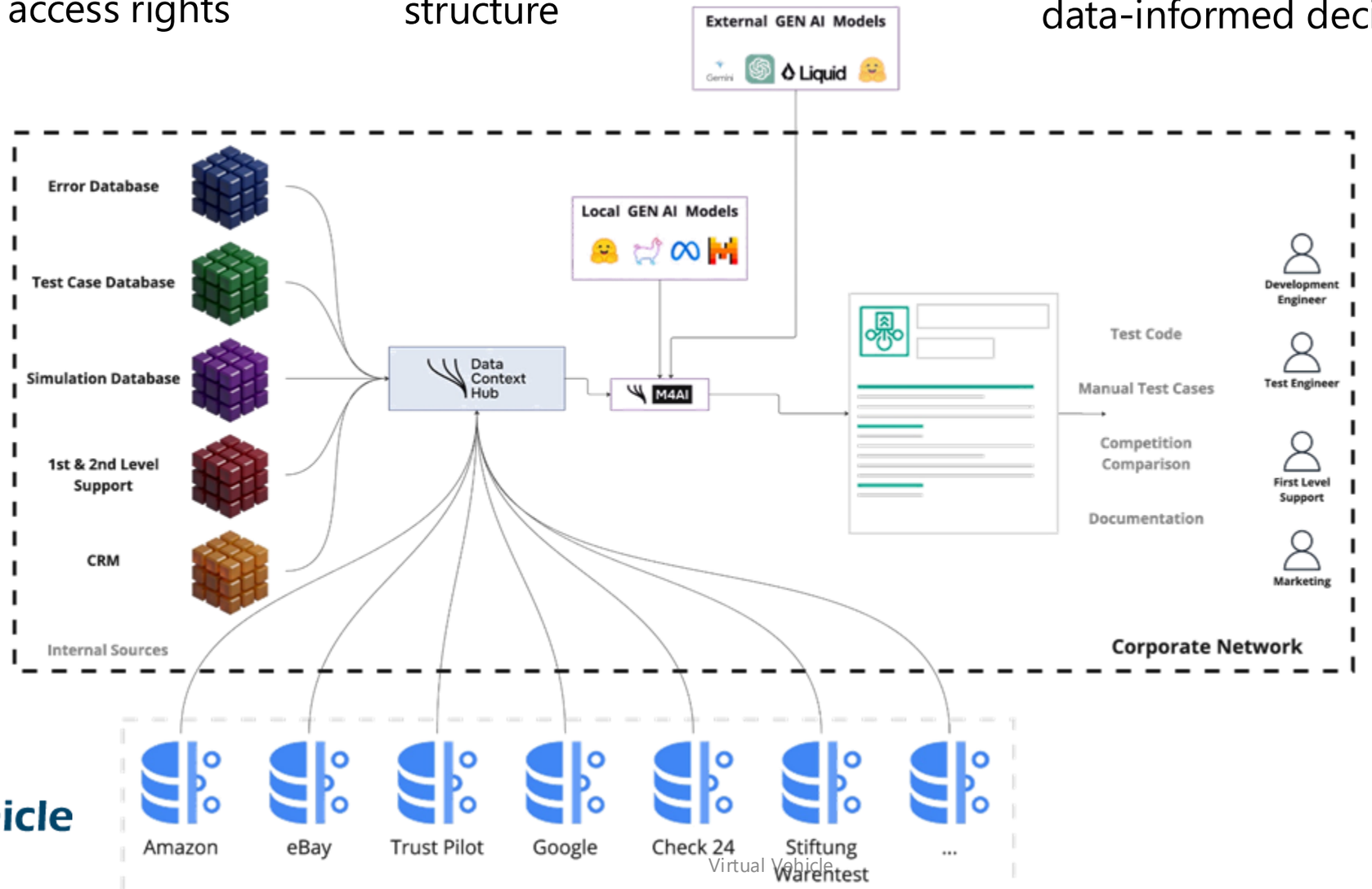
Contextualisation of distributed data

Data Context Hub

(1) Integration of distributed, heterogenous data while maintaining access rights

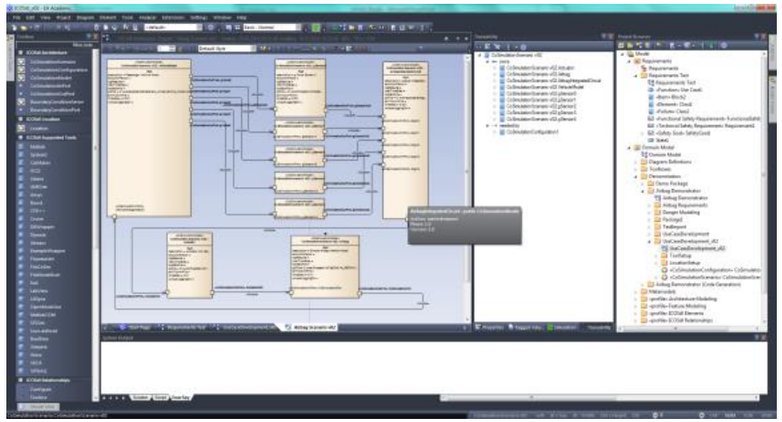
(2) Contextualizing data in an efficient and robust graph structure

(3) AI/LLM methods for reliably understanding data and enable data-informed decisions



virtual vehicle

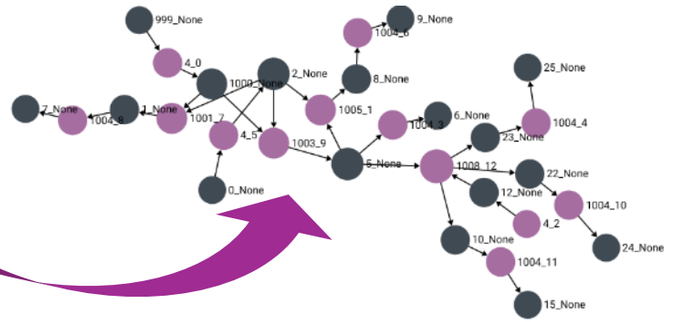
High-level Automation of credible Simulation for Virtual Approval



Functional Architecture modeled in MBSE Tool, like Enterprise Architect (EA) or System Architecture Modeler (SAM)
➔ Sysml-2

Import of system information like: interfaces, test-cases, simulation models, configurations etc.

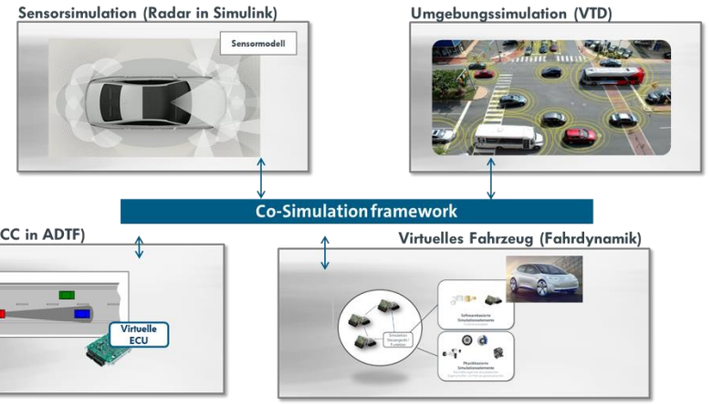
Additional test-stages for Simulation Credibility

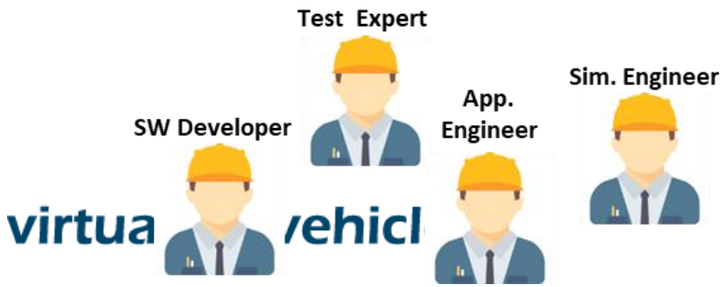


Central, graphbased Databasis in the backgroud for interlinkage of Dev‘t artefacts (interfacing distributed information)

Design Changes

Generation of Automation Pipeline for Execution Automation





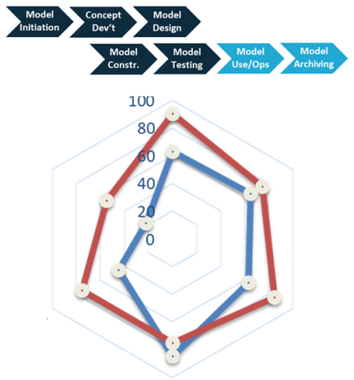
Evaluated KPIs / AI-based


UPSIM
UNLEASH POTENTIALS IN SIMULATION

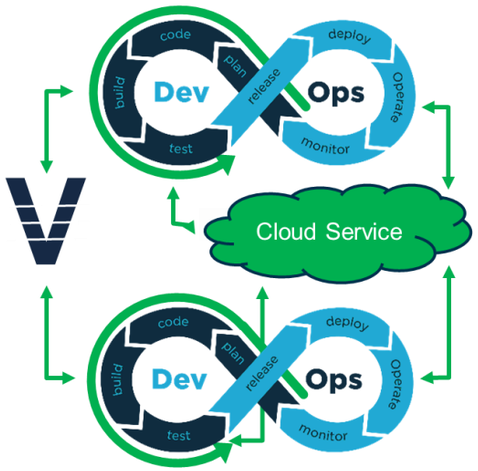
Spotlight ITEA3 Project UPSIM *(30 Partners, 6 Countries)*

- How to derive a method & process to assess the **quality of models and simulations**?
- Result of UPSIM ➔ being prepared for an industrial standard
- M&S SPICE specification by intacs® WG Q3/2023 (start date)

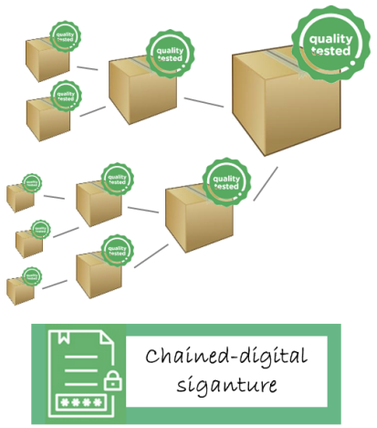
1 ***Credible Digital Twin Readiness Levels***



2 ***Continuous Collaboration***

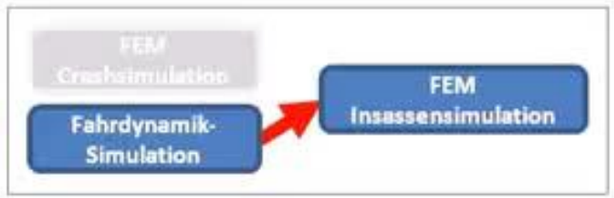


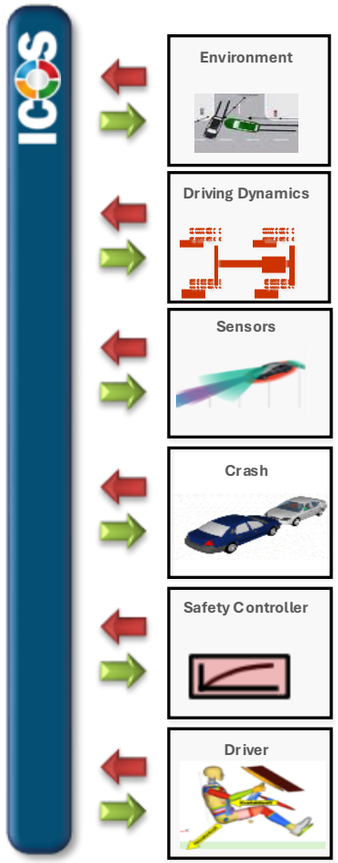
3 ***Unique Identification***

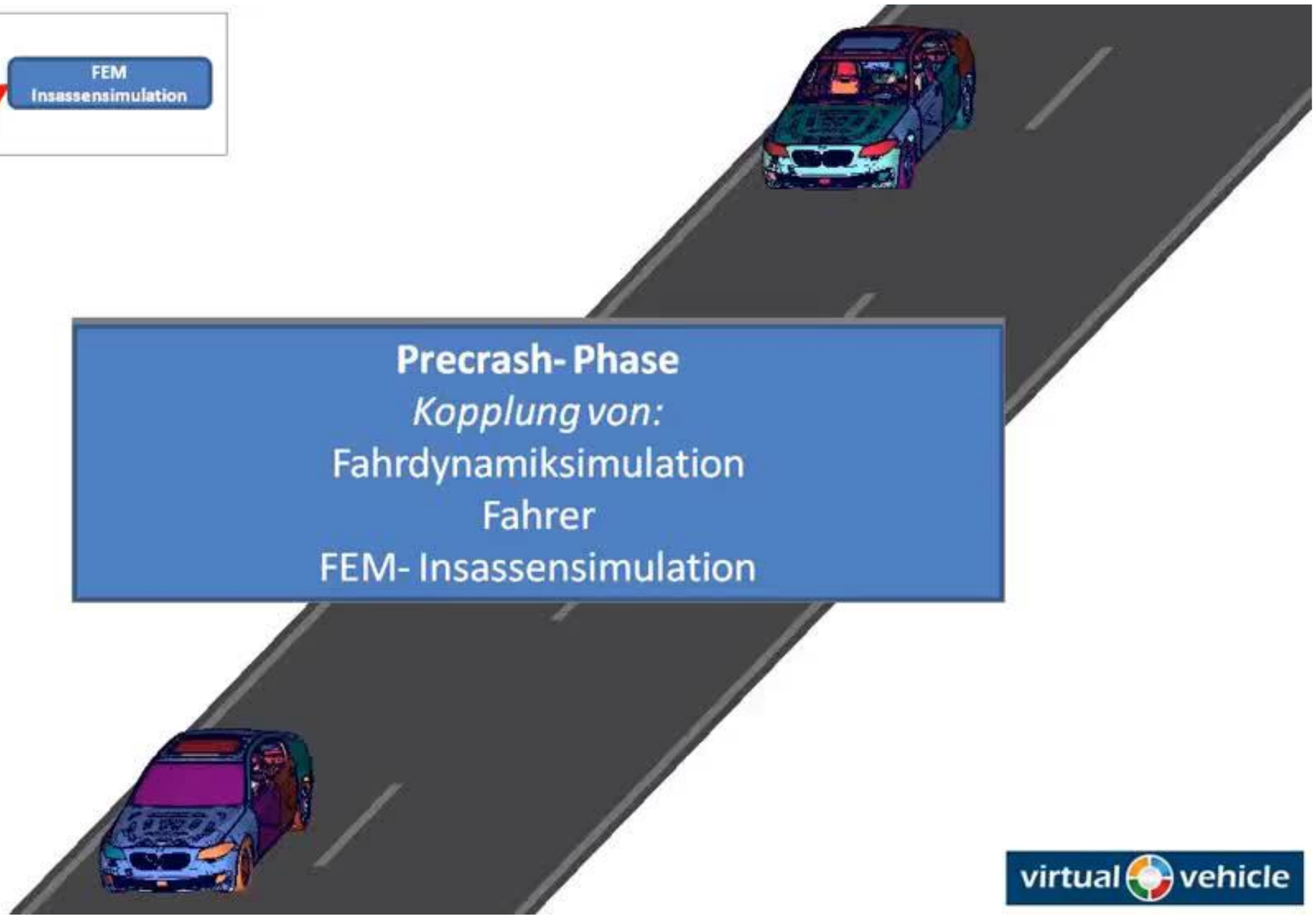


virtual vehicle

Reliable system simulation

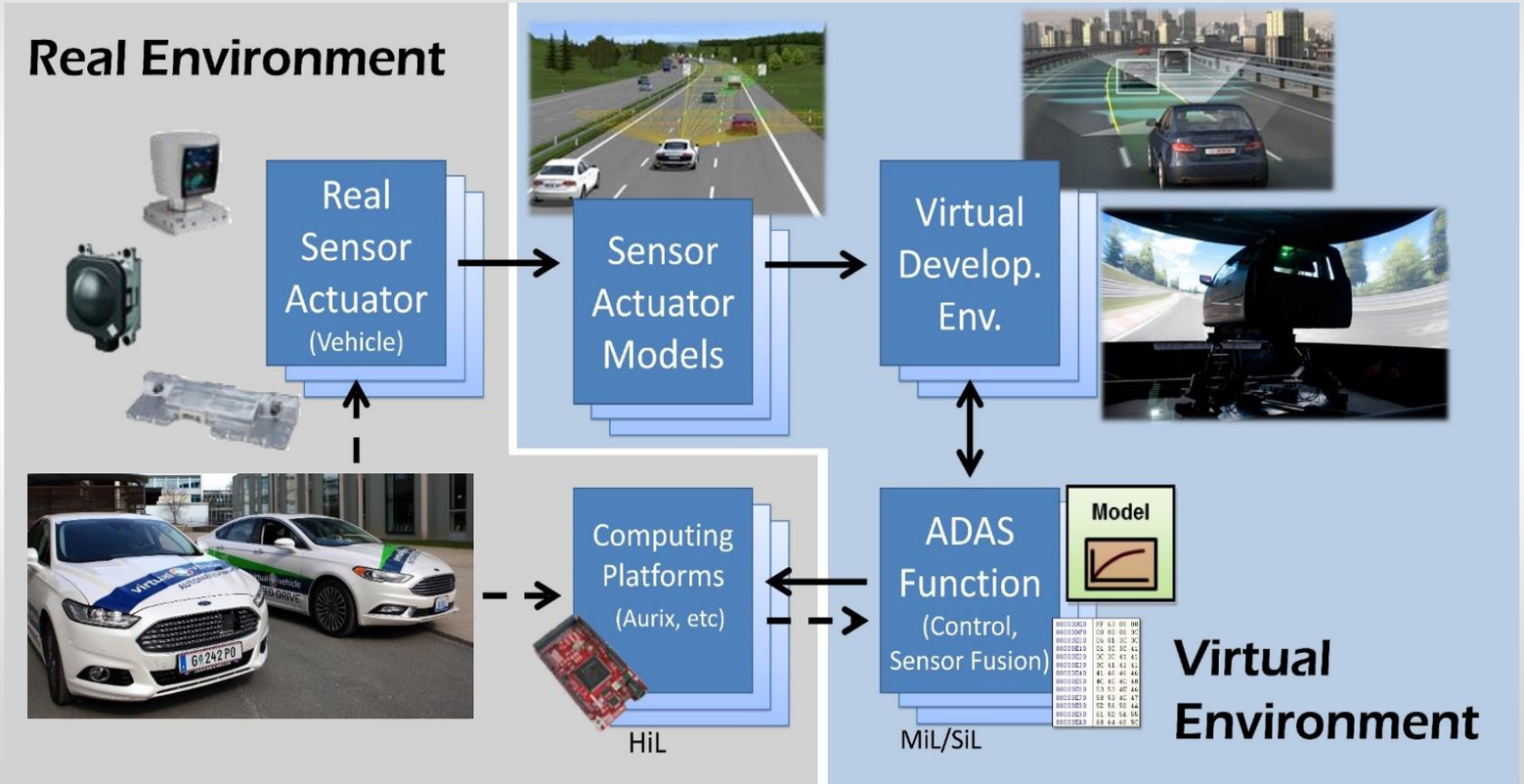






First autonomous research car in Austria

HW/SW co-design for automated driving



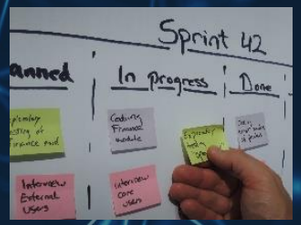
- **Fusion of real and virtual testing**
- **Test of E/E architectures and SW-Stack**
- **HW-SW co-design in virtual environment**

virtual vehicle

Future Engineering – Key Enablers and Fields of Activities

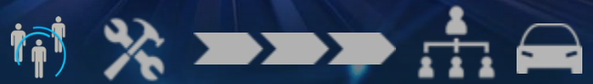
Handling complexity

Ability to adapt



Collaboration

Speed – Time to Market



Culture, mind-set

Future Engineering – Key Enablers and Fields of Activities

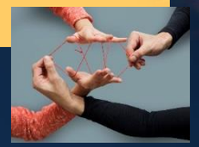
Handling complexity

- Providing valuable context
- Single point of truth / source / access
- Simplification of IT architecture

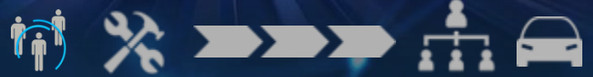
Data-Driven Development
- ***Automated Engineering***
- ***Software-Defined Vehicle***
- ***E/E Architecture - HPC***

Collaboration

- Flexible viewpoints on data and relations
- Context from any perspective
- Graph security layer



Speed – Time to Market



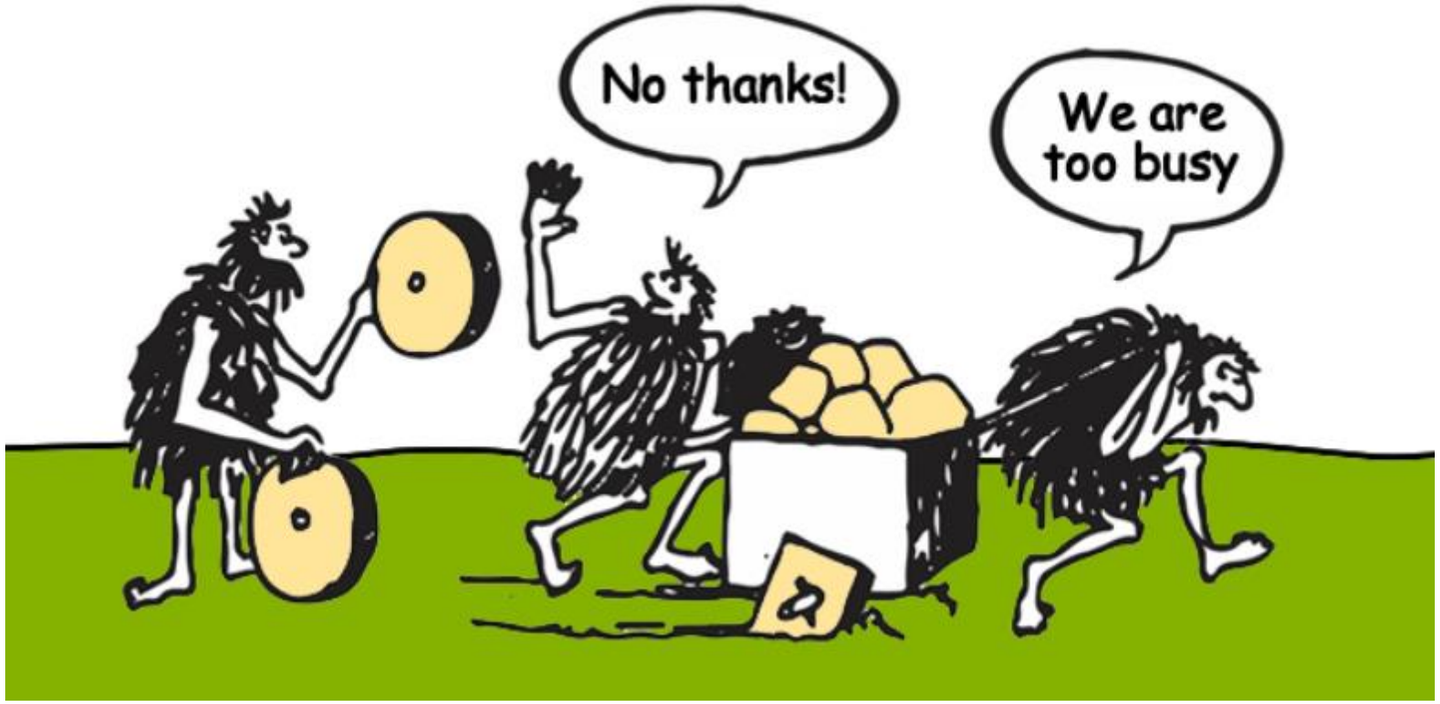
Ability to adapt

- No proprietary data model
- Enterprise specific knowledge model
- Agile data modelling
- Brownfield & greenfield capability

Culture, mind-set

- Scalable from need2know to good2know
- Reliable and traceable data and context

The Most Important Skill for the Future is Change Agility



THANKS!

Dr. Jost Bernasch

CEO

Summary

1. The development of complex software-defined vehicles requires scalable, versatile software and hardware platforms

2. Handling the different time scales of hardware and software development and managing data is a basic condition for success

3. Data-driven SW-HW co-design is key: Enabling MBSE based development, automated engineering, co-simulation, co-verification and agility in technology integration.

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Systems Safety Security Software

Chips JU – open source hypervisor
→ approval for automotive

FEDERATE

Chips JU - Building Blocks for SDV

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