virtual vehicle
ACCELERATING INNOVATION

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FROM SENSOR TO APP

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DE-RISKING OF FUTURE RAIL SYSTEM TECHNOLOGIES BY MEANS OF RESEARCH AND TECHNOLOGY DEVELOPMENT WITH FOCUS ON SERVICE ORIENTED, MODULAR DESIGN AND VALIDATION FRAMEWORK

Mechanik | Mechatronik | Elektrik | Elektronik | Software | Software-Defined Systems Next Gen. Simulation Techechnology

Gesamtsystem Simulation

Rail & Automotive

2002 | 2008 | 2018 | 2026

2002	2008	2018
20 MA	90 MA	300 MA
EU 0	EU 13	EU 40 Shift2Rail
TU Graz, JR, AVL, Magna	Siemens	Infineon voestalpine
1:2		1:4

K2-COMET Rail since 2004

R&D Projects addressing Vehicle-Track Interaction

Siemens Mobility Graz as Shareholder since 2007

First rail industry partner as shareholder

SHIFT2RAIL Associated Member since 2016

Governing board member, SIWG Member, TD-Leaders, Project Leader

voestalpine as Shareholder since 2019

First rail infrastructure industry partner as shareholder

Project Partners

Siemens, voestalpine, ÖBB, SBB, DB, P&T, Getzner, CAF, Knorr-Bremse, PJM, Liebherr, TU-Graz, University of Sheffield, KTH, MCL, AC2T, Chalmers, Newcastle University, …

Rail R&D since: **2004**

Staff Rail Systems Research: **35+ HCs**

Development & Engineering → Homologation & Production → Operation & Maintenance

Virtual Prototype

GRITLAB

Digital Twin

Wheel-Rail Interaction and Vehicle Dynamics

- Model Development & Virtual Assessment (LCC)
- Dynamic behaviour of vehicle and track
- Holistic wheel-rail tribology and Material Modelling
- Damage & Deterioration and Track Settlement
- Model validation and virtual vehicle certification
- Noise & Vibrations

Holistic Railway Systems Analytics and Digital Twin Networks

- Continuous vehicle & track components health monitoring
- Decision support systems: cognitive & predictive analytics
- Prescriptive analysis framework
- Functional features of components and sub-systems
- Process automation for traceable, consistent assessment

Physical Modelling

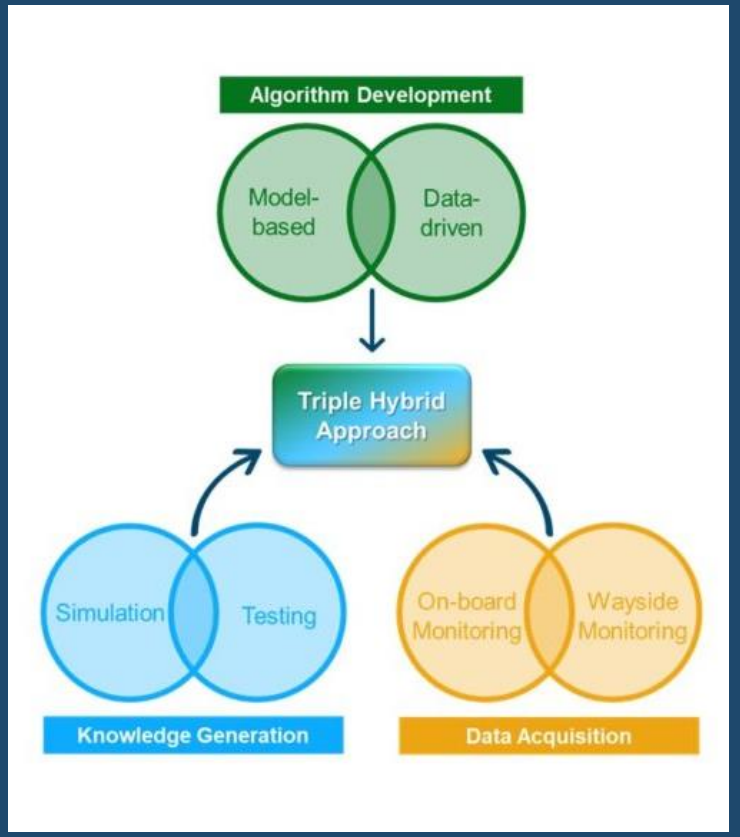
Data Analytics

Triple Hybrid Approach

Holistic approach to answer questions regarding the **design and maintenance (LCC)** of rail transport technology including vehicles and tracks

Depending on the exact research question, knowledge from a total of three pairs of solutions are used:
(1) Data Acquisition, (2) Algorithm Development amd (3) Knowledge Generation

With the goal:
From Data to Trust ⟶ Approved results to Application



This approach, called *Triple Hybrid Approach*, represents a unique selling point of ViF and is to be established in the industry as VIRTUAL VEHICLES's method and serves as a quality feature / seal of approval

Virtual Validation Framework

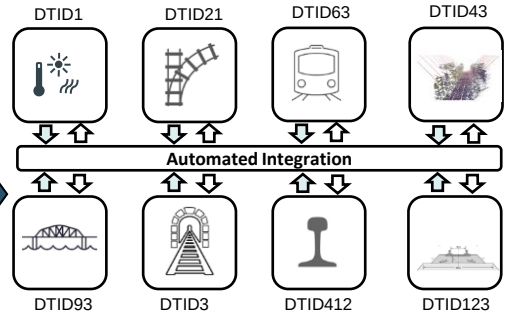
Hypothesis

- Operational Rules
- Component Design
- Asset Deployment & State-of-Health
- Countermeasures

Digital Twin Library

- Simulation Artefacts
- Data Warehouse
- Validation Scenarios

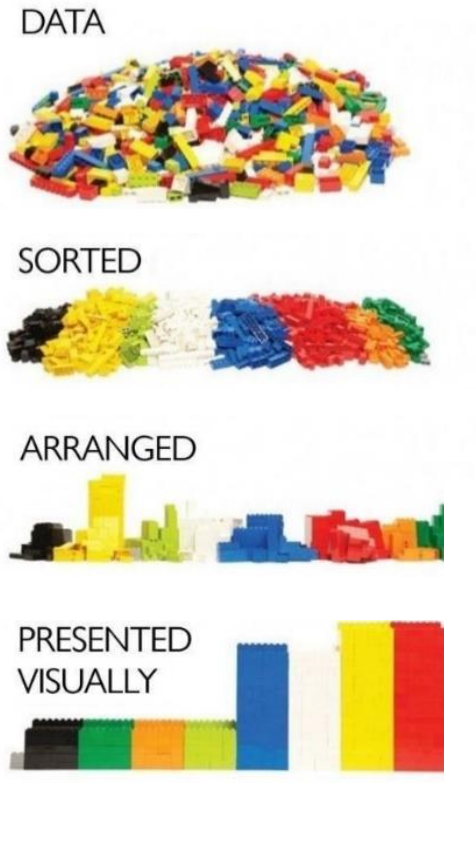
Configured System



Assessment

Process automation for traceable and consistent assessment

- In-house sensor design and validation
- Holistic system understanding as an important basis
- State of the art physical models combined with methodologies such as AI and ML
- Triple Hybrid Approach and iterative (DevOps) processes
- Graph-based information processing including state-of-the-art IoT technology
- Clear communication of the most important results and recommendations for action
- Speed vs. Trust



Source: Andreas von der Heydt

Data visualization <-> Data storytelling

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Thank you

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