VOLVO

DURATWIN

A Digital Twin for Durability to Accelerate Development and Enable Predictive Maintenance

Volvo Group

Volvo GTT | Platform Analysis, Structure | DuraTwin_SEES_Autumn_2024 / Linnéa Jern

2024-11-13

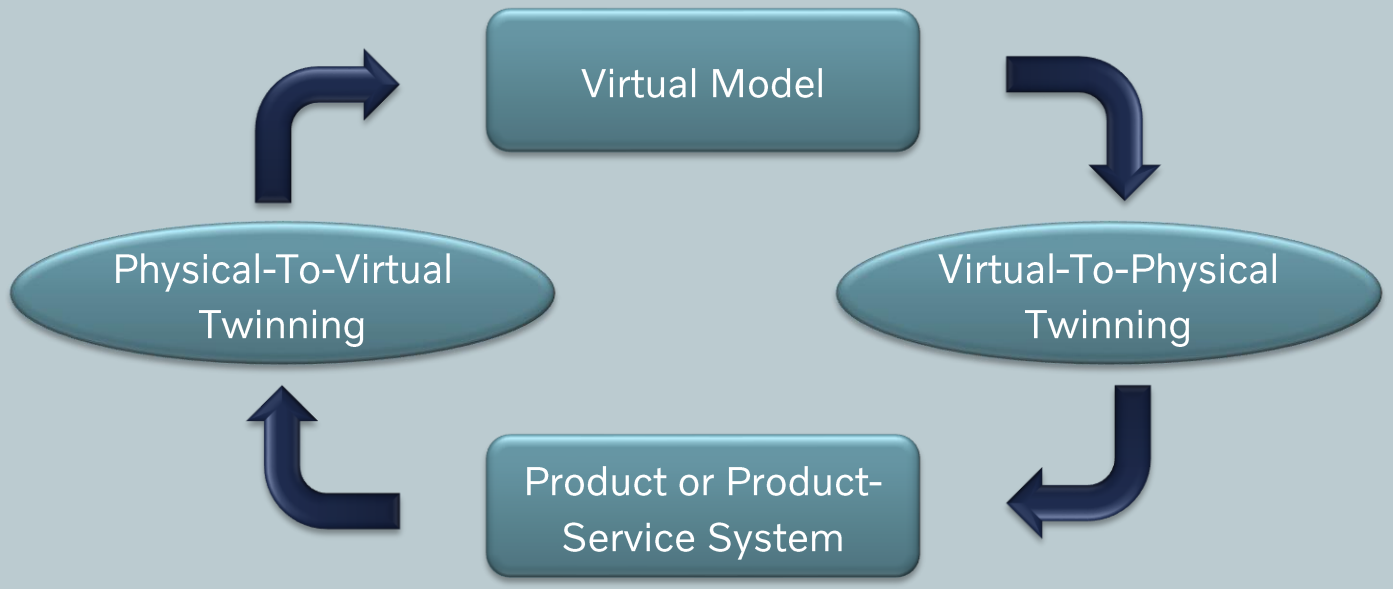
Introduction

DURATWIN

- Project started *2024-08-16*
- Collaboration between AB Volvo, Volvo Cars, RISE and Chalmers
- Financed by: Vinnova/FFI

	Participant	Role & Responsibility
Volvo GTT	Linnéa Jern	PhD Student
Volvo GTT	Andreas Josefsson	Project Manager & Indutrial Supervisor
Volvo GTT	Sofi Sjögren	Assistant Project Manager
Volvo GTT	Fredrik Öijer	Expert on Vehicle Durability
Volvo GTT	Magnus Ahlstedt	Expert Engineer, Road Simulator
RISE	Martin Olofsson	Senior Researcher
RISE	Albin Bäckstrand	Senior Researcher
VCC	Anders Nord	Senior Researcher
VCC	Anders Sjögren	Senior Researcher
VCC	Anders Wirje	Senior Researcher
Chalmers	Håkan Johansson	Academic Supervisor
Chalmers	Peter Folkow	Examiner

Digital Twins



A digital twin is an integrated data-driven virtual representation of real-world entities and processes, with synchronized interaction at a specified frequency and fidelity.

- Definition
- Digital Twin for physical modelling
  - Not explored much
  - Geometrical models most common

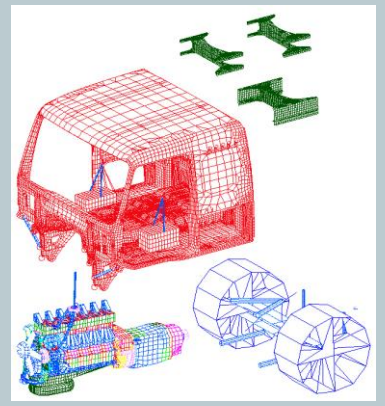
Complete Vehicle Models

- FE-models of complete vehicles
- Software developed in-house to:
  - Build Nastran models from truck specifications
  - Post-process results
- Database with road profiles:
  - Proving grounds
  - Customer environments

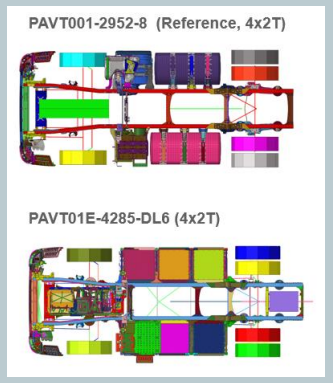
Complete Vehicle Models

What are their applications?

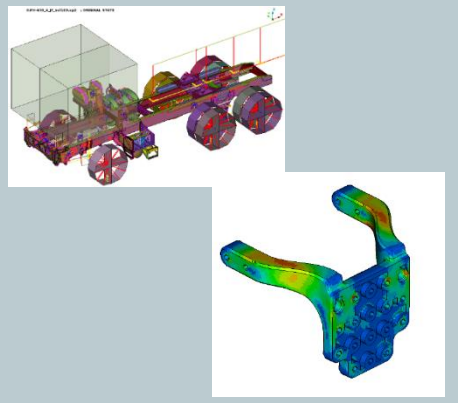
Conceptual studies



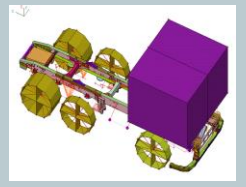
Continuous design evaluation with reference models

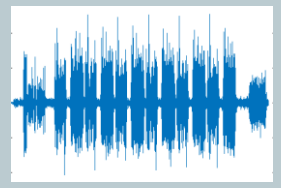


Component Analysis



Generate input signals to rigs

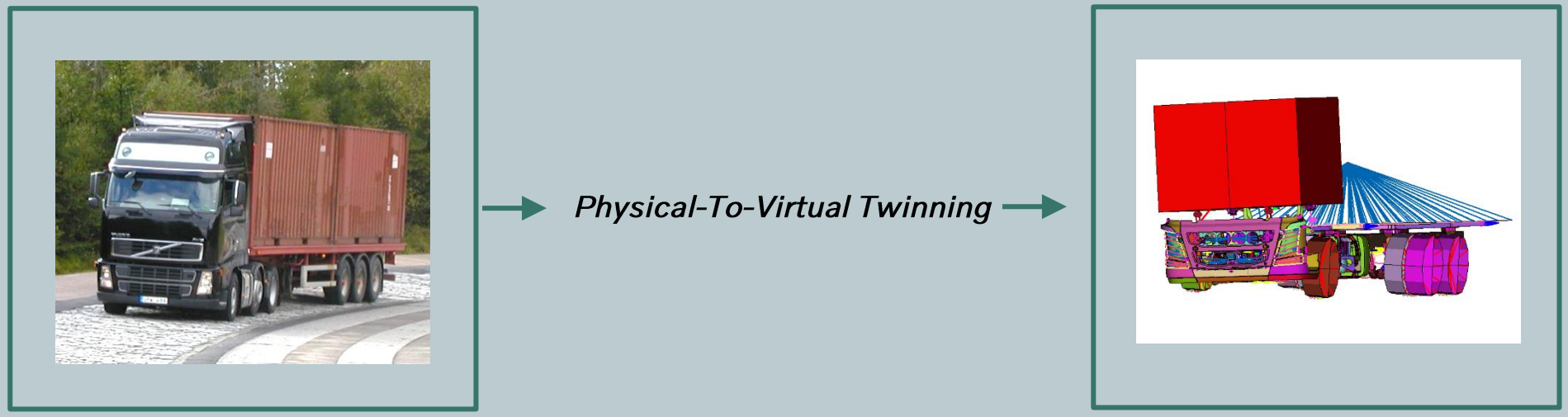




Digitial Twins

Vision #1

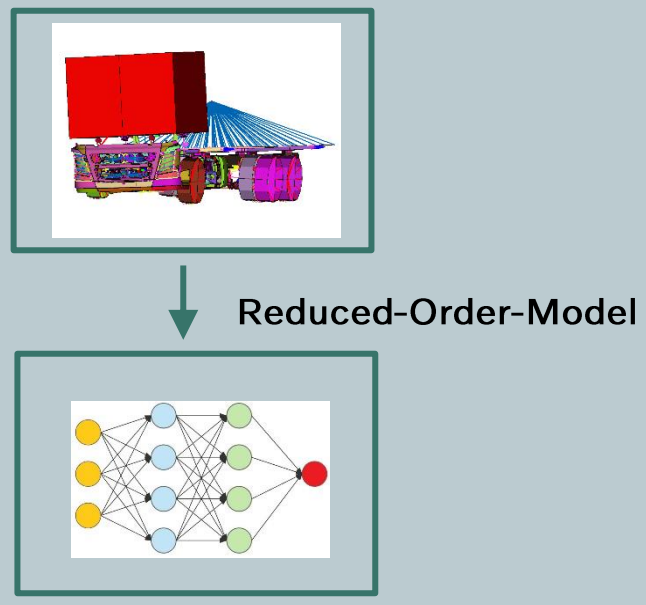
Live simulation running @ engineering desk

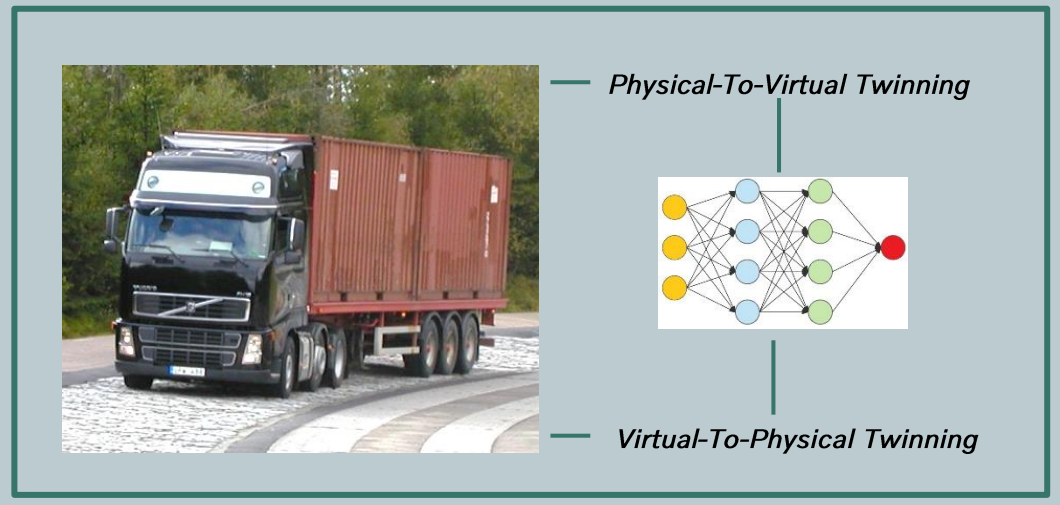


PURPOSE: Follow a test in real-time with a model (enhanced testing), estimate full stress and strain response in components during test (virtual sensing), etc.

Vision #2

Simulation model deployed into truck software



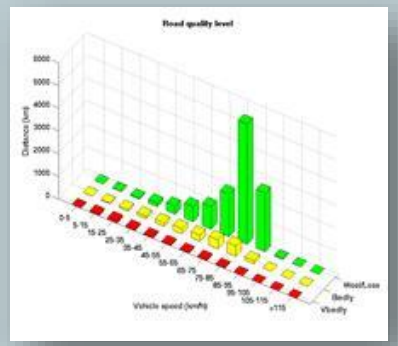


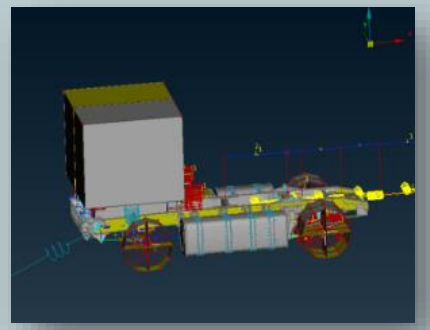
PURPOSE: Enhanced testing (virtual sensors), load identification in field, predictive maintenance.

Vision #3

Online (or offline) calculation based on logged road-parameters. No real-time synchronization, but the concept can be elaborated.

Logged data @ customer





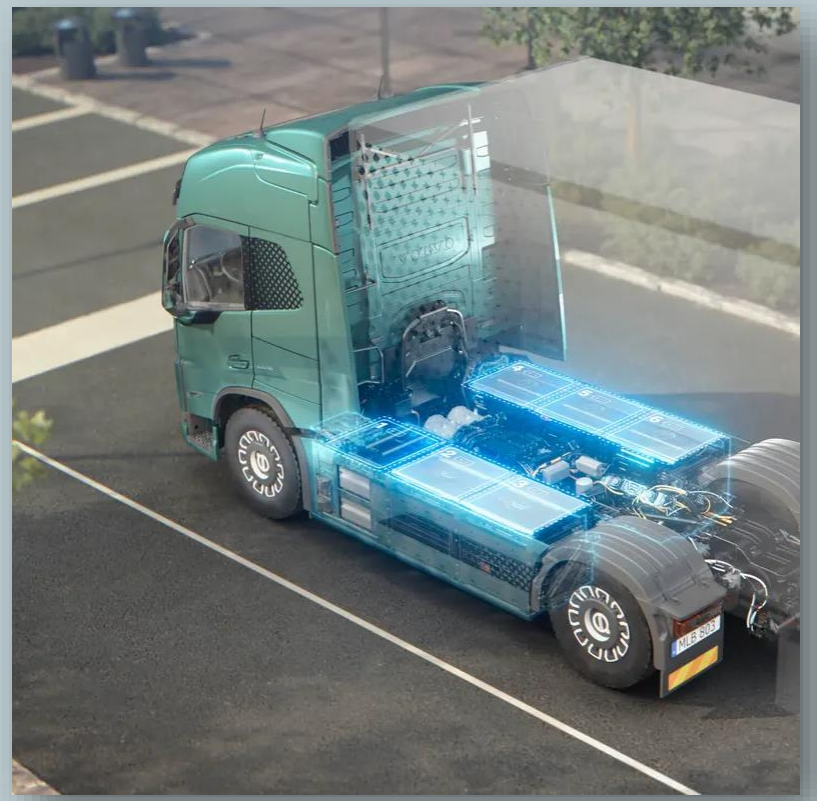
- Synthetic roads with equivalent damage
- FE-models

DuraTwin

These ideas are now explored in the ongoing research project.

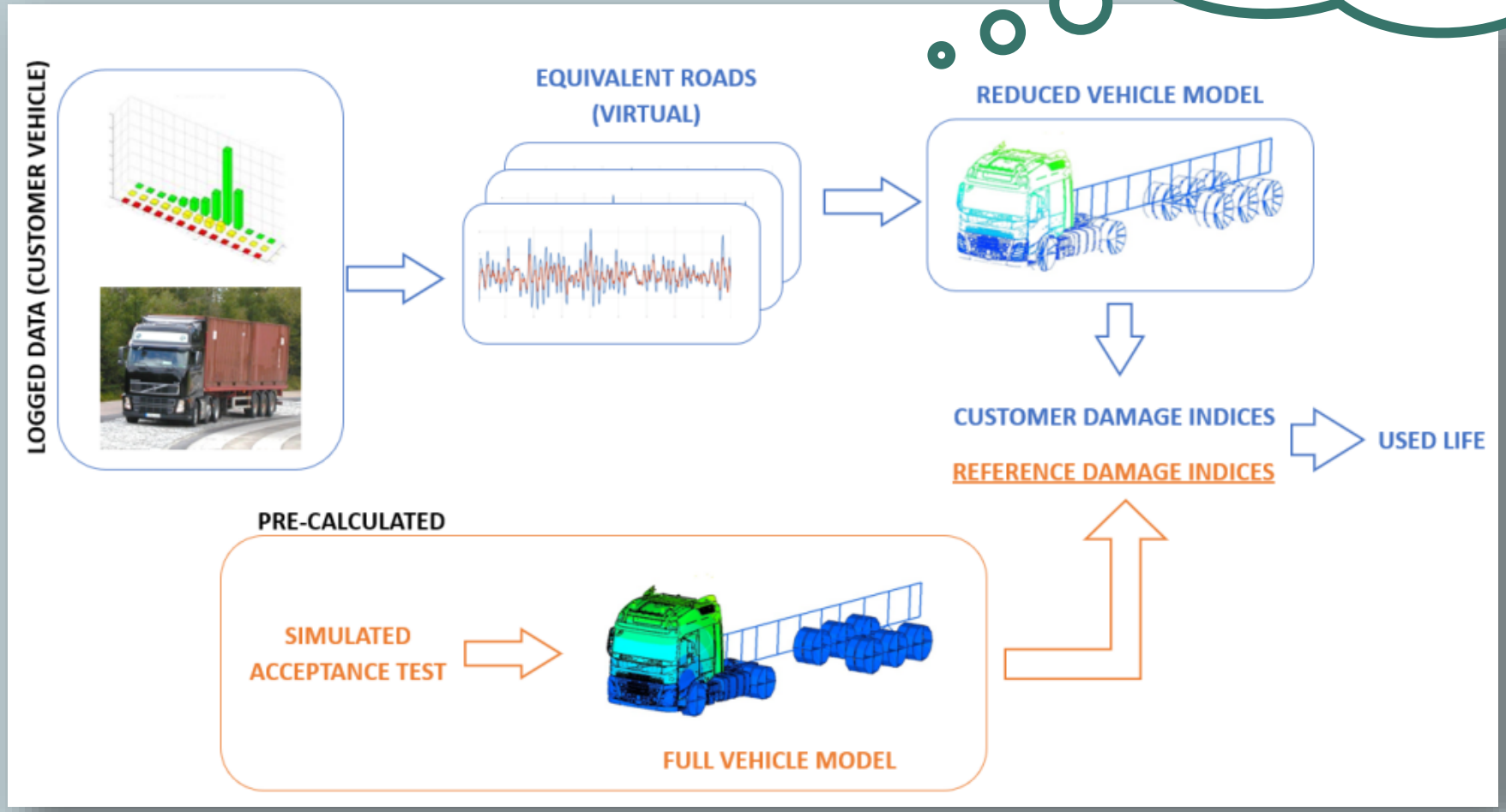
Digital Twin for Vehicle Durability to Accelerate Development and Enable Predictive Maintenance

- Accelerate ongoing development of clean and energy-efficient technologies.
- Offer new services in the form of predictive maintenance.
- Increase of vehicle up-time.
- Support circularity through re-use.

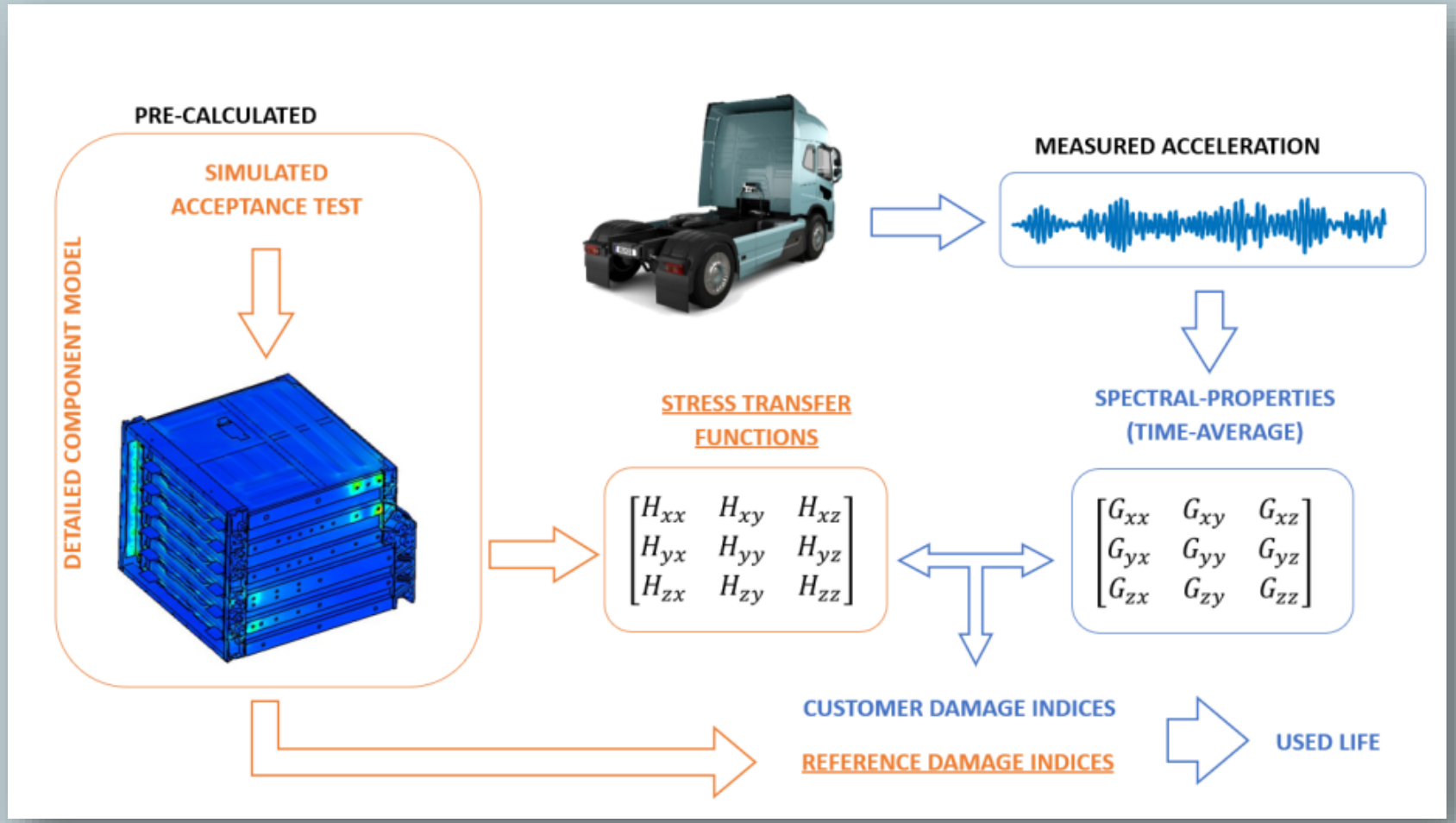


Vehicle strategy

How to represent the reduced vehicle model in the digital twin?



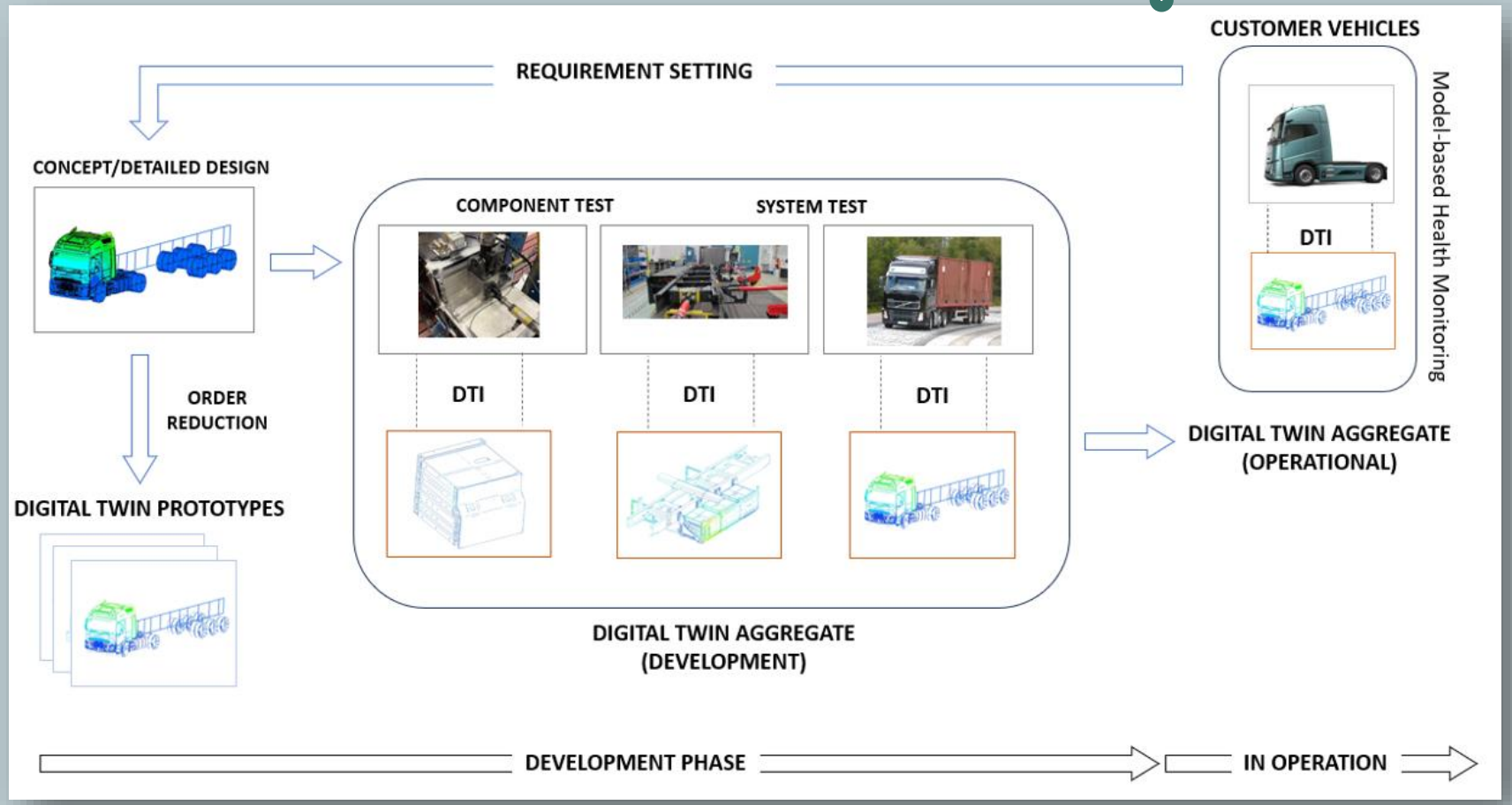
Electrical component strategy



How to build the Digital Twin Prototype so it can enable seamless synchronization with test data?

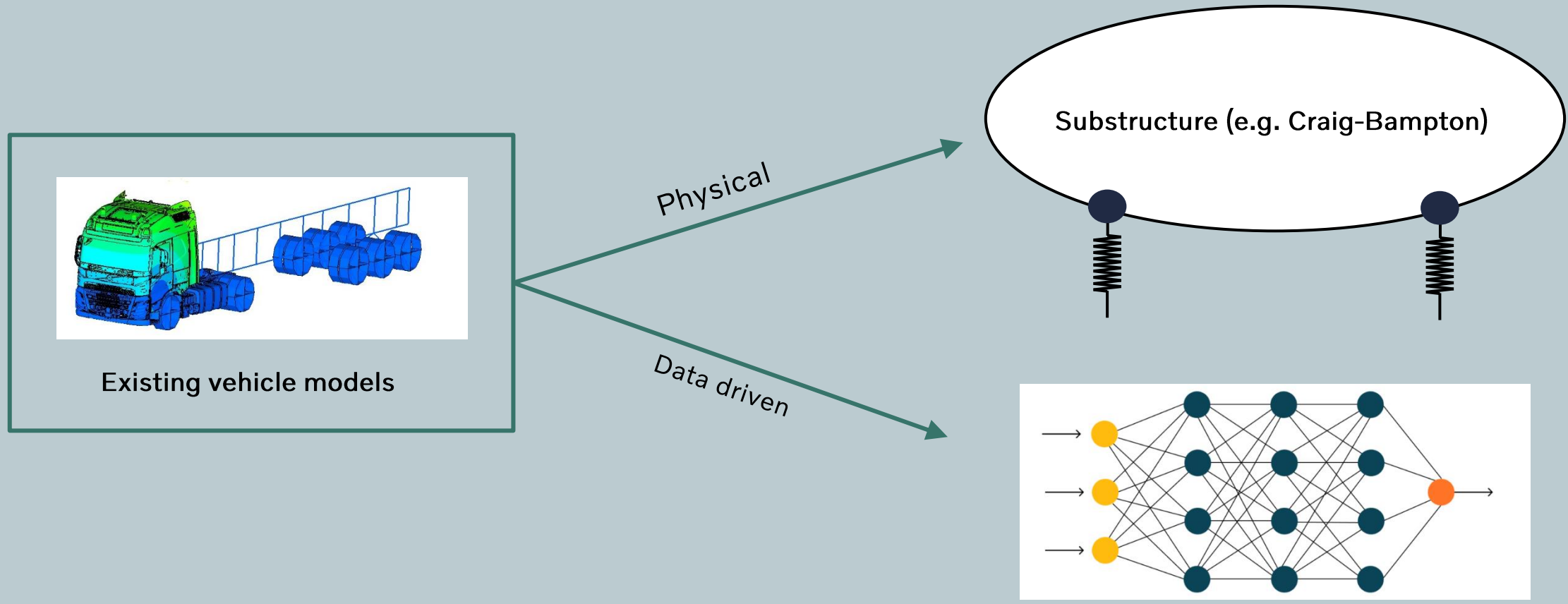
Implement into product development

Integrating digital twins into the product development process.



Strategies for Reduced-Order Modeling

Exploring two strategies: Physical or data driven (or both?)



Research questions

1. How can vehicle models be reduced to computationally efficient models that can be used for health monitoring?

2. What strategies can be used to enable health monitoring of vehicles and vehicle components, and how can these be implemented into the product development process?

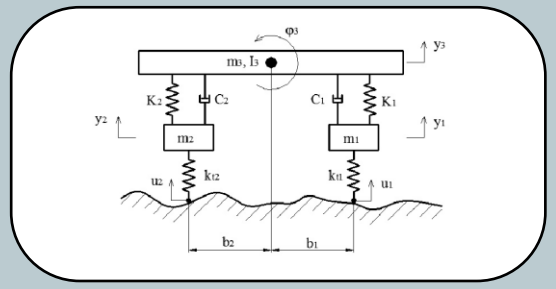
3. How to implement the digital twin solution into a real vehicle to create a live demonstrator and a platform for future testing and development of the technology?

Three types of models

Important to find a good balance between low and high fidelity

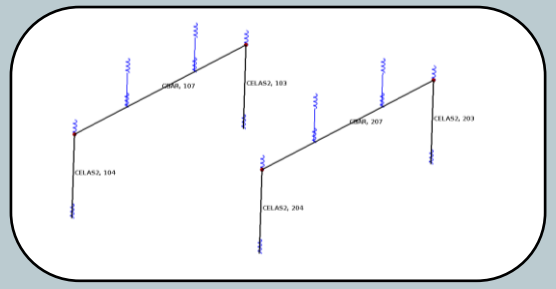
ongoing

A. Lumped mass systems (Matlab/Python)



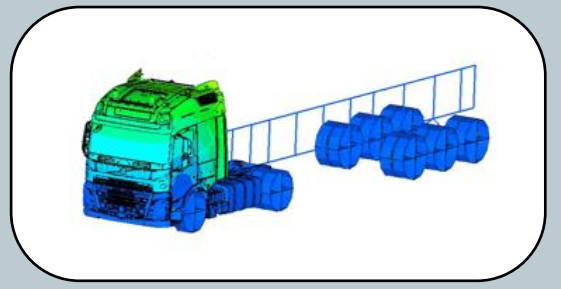
- Easy to understand and fast to run.
- Useful in publications.
- Easy to use to quickly evaluate methodolgy.
- Generic vehicle model interesting for cooperation between AB Volvo and VCC.

B. Simplified FE-models (Nastran)



- Alternative to A.
- Quick to build.
- The models can be run with the analysis methods used for industry models.
- Better or worse alternative, depending on what is requested.

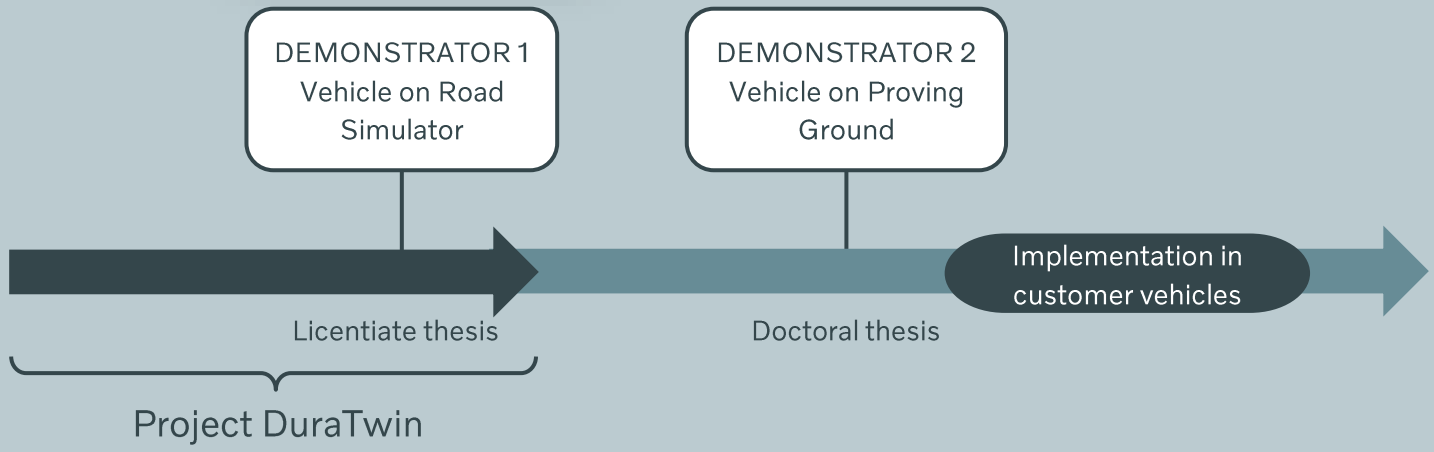
C. Industry-models (CVM/Nastran)



- Sharp models which are used in product development.
- Useful when verifying methods.

Way forward

From Project DuraTwin to implementation in customer vehicles



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QUESTIONS?


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