



AI-Powered Vehicle Engineering Solutions

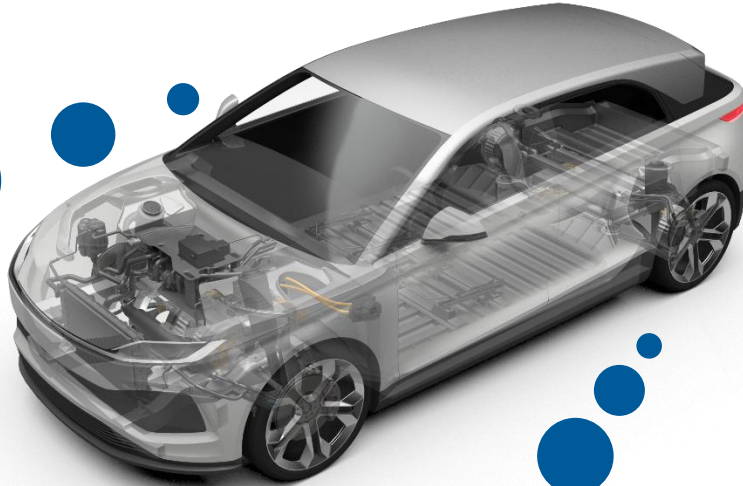
Waseda Symposium 2024

Stefan Bruhnke

Automotive Trends & Challenges for Vehicle Development

ADAS

- Autonomous driving
- Integrated safety solutions
- Vehicle as communication & data center
- Functional safety



Vehicle

- Software as differentiator
- Recycling and sustainability
- Decarbonization

Powertrain




- Technology openness
- Renaissance of Hybrid and REX
- Battery costs dominate the vehicle price
- Localization of battery development & production / new technologies without rare earth

Source: Markus Schäfer, Member of the Board of Management of Mercedes-Benz Group AG, in an interview with press-inform, May 2024

“Shortening development times is crucial to meet the growing demands of our customers and to shorten innovation cycles. By integrating digital technologies and agile methods, we can respond more quickly to market changes and remain competitive.”

The high product development speed of Chinese OEMs and new players challenges Japanese and European OEMs

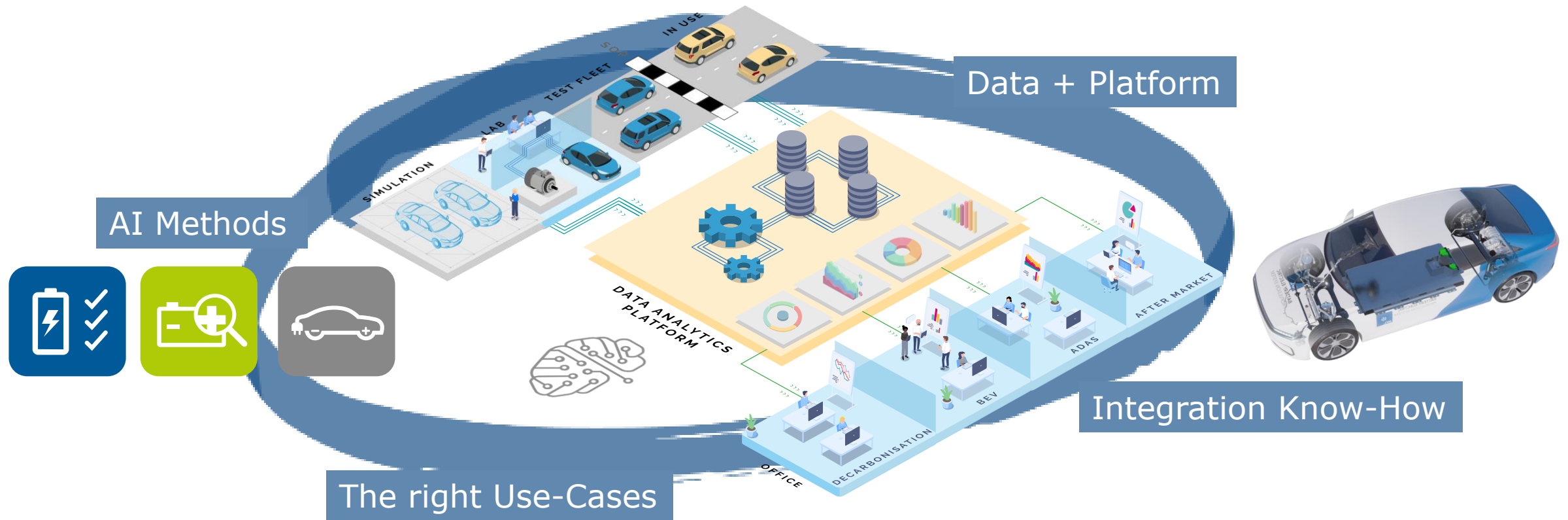


	 China	 Europe	 Japan
Facelift	10	>19	18-24
New Vehicle	19	36-52	35-40

Development times for passenger cars
[in months]

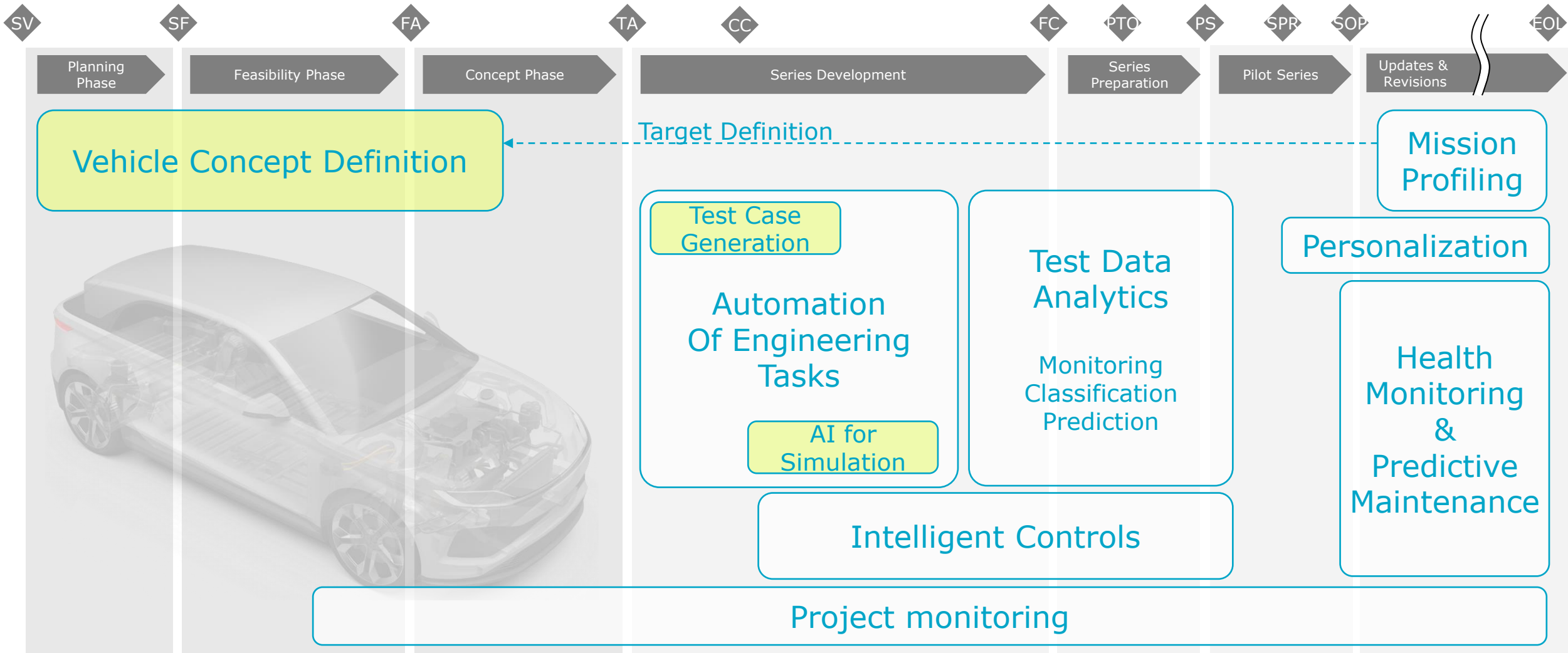
The use of AI is a good approach to reduce the development time, besides hardware measures like shortening testing or tool running time, while maintaining quality and keeping risk low.

New Skills and Tools are Essential for AI Implementation

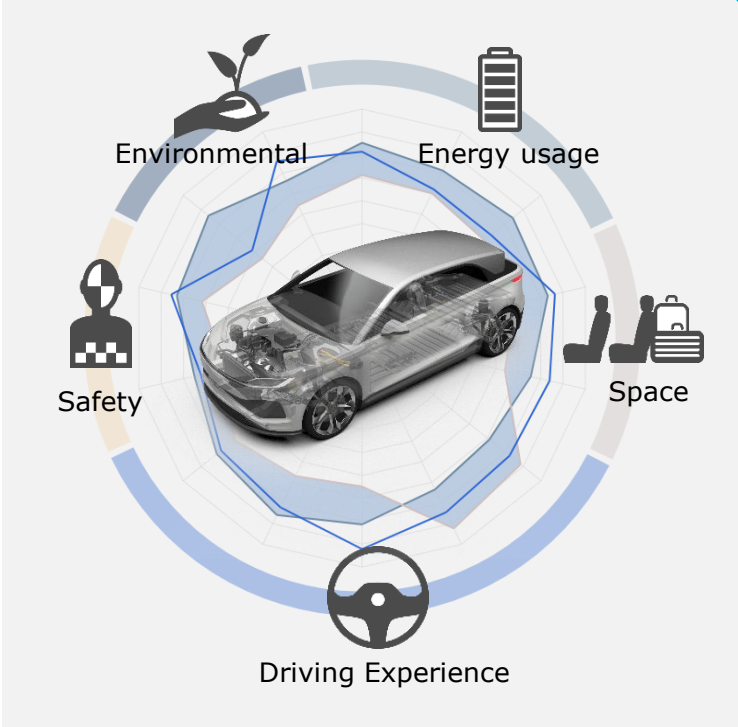


Bridging the gap between engineering and data experts is the key to successfully utilize AI in vehicle development.

Potential of Artificial Intelligence across Automotive Development Life Cycle



As Fast as Possible from Customer Expectation to Targets & Architecture



Typically, 6-12 months from Start of Feasibility to Target Agreement / Concept Agreement.
How to shorten it? How to manage?

AI Powered Concept Development

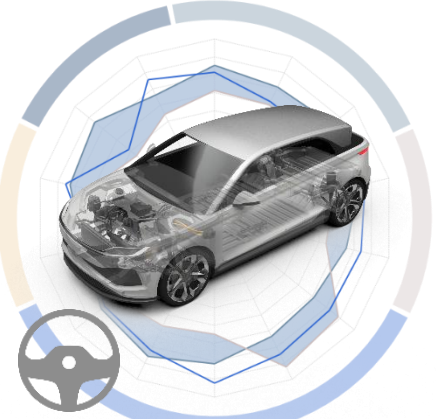
Technical Specification

- Powertrain
- Thermal & HVAC
- Chassis
- Body
- E/E & ADAS/AD

Predictive Models

- Energy Management
Thermal
Charging
- Vehicle Dynamics
Performance
Driveability
Braking
- Geometric Vehicle Layout
Packaging
- Crash Durability
- In development
Ride Comfort
NVH
- In development
Costs
CO₂ Footprint

Attribute Optimization

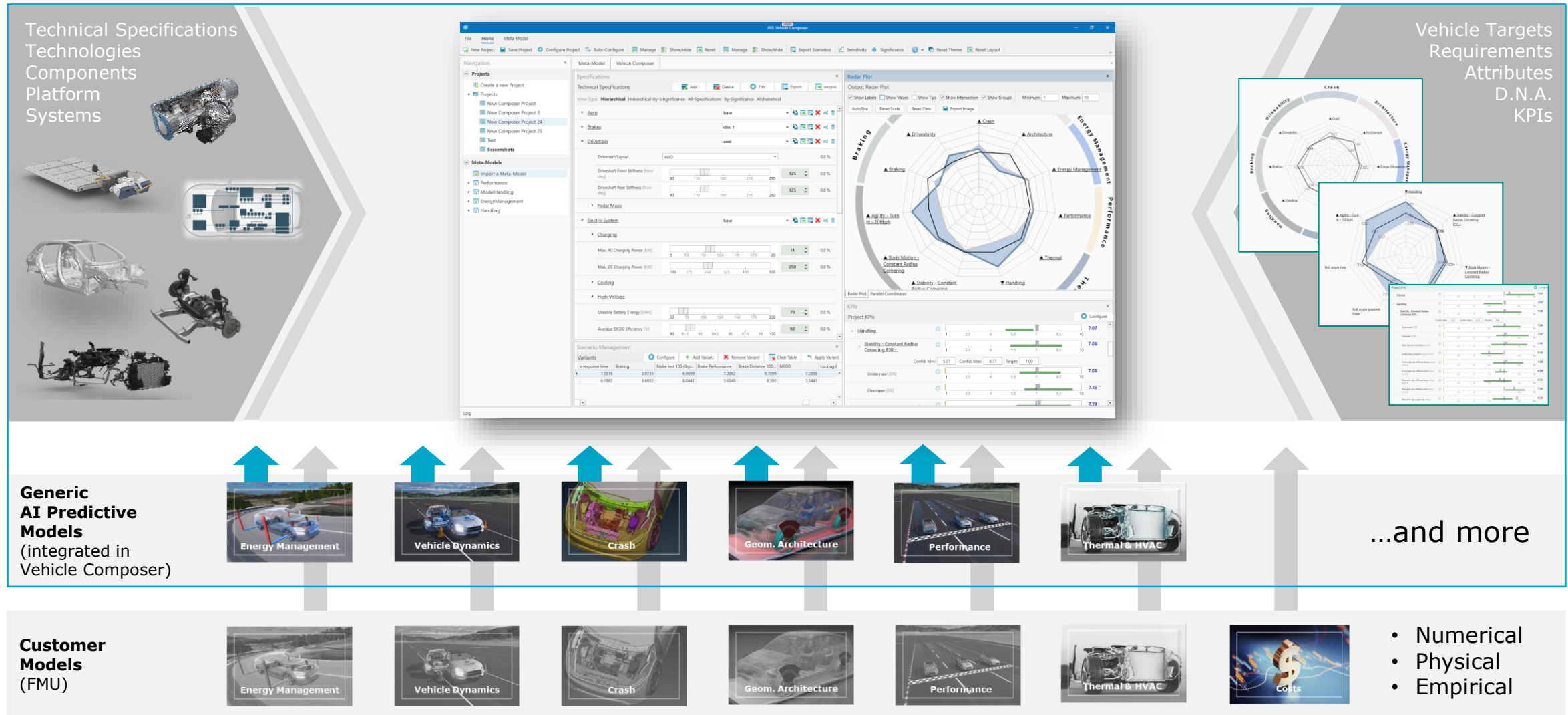


Handling



Solution Architecture

Vehicle Concept Definition



Development Partnership

AI-Powered Vehicle Concept Development

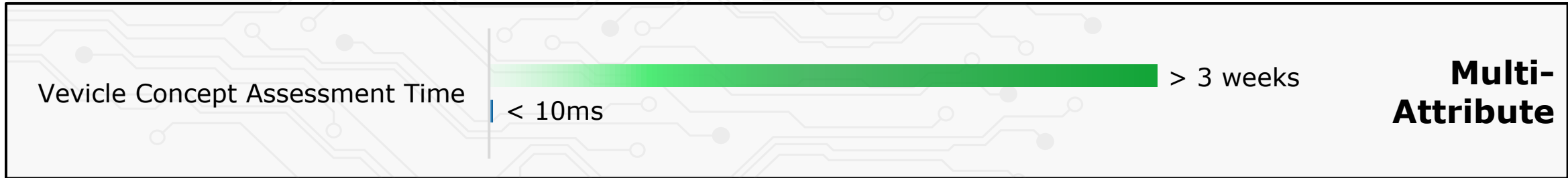
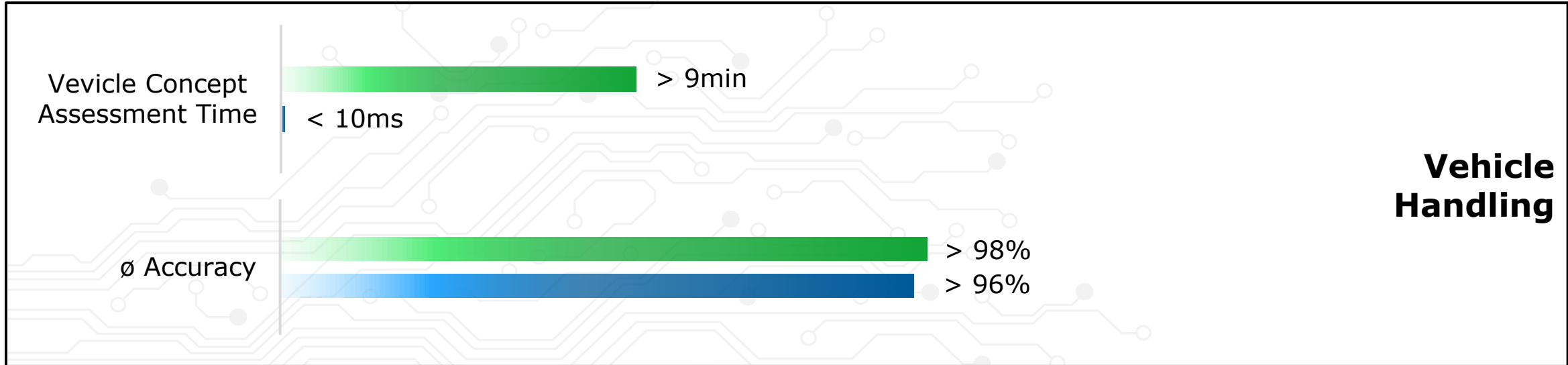
Vehicle Concept
Definition



HYUNDAI

AVL 

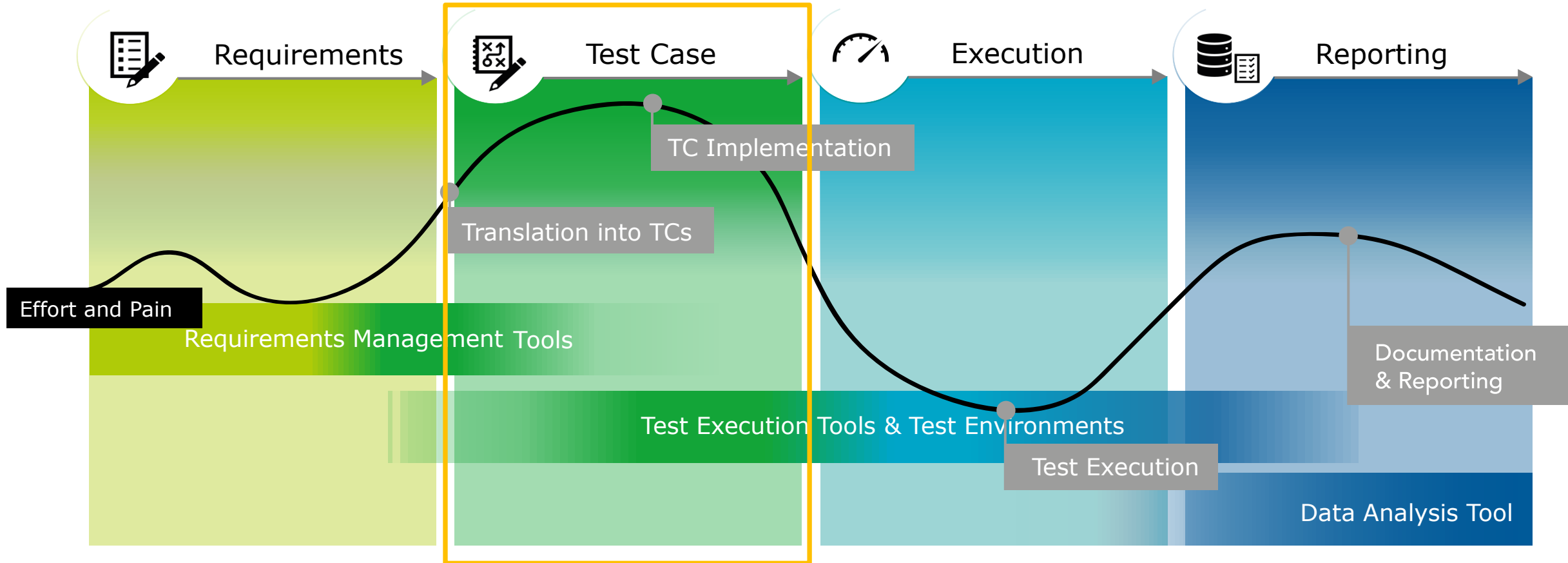
Customer Benefit



Conventional Attribute Engineering vs. AI Powered Attribute Engineering

AI Powered Attribute Engineering is easy to use and enables balancing of cross influences in real-time.

Classical Functional Testing Workflow and Challenge

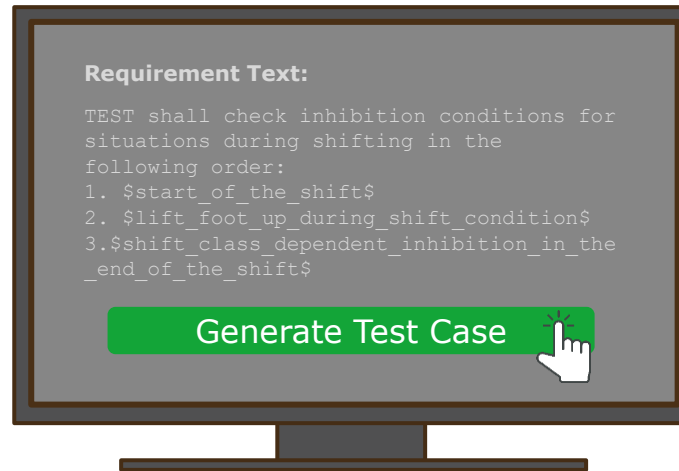


During the functional testing process the test case generation causes the biggest effort and pain.

Generative AI for Vehicle Development: Test Case Generation



Source: <https://de.vecteezy.com>



Enter requirement text

Click "Generate Test Case"

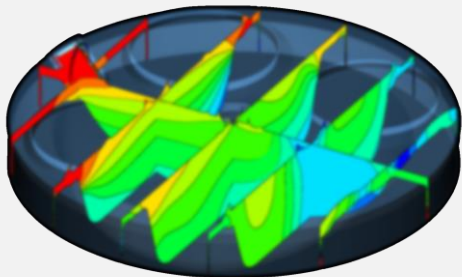
Receive the code

Through the use of generative AI and Large Language Models (LLM), the efficiency of test case generation can be increased by as much as 20% immediately – potentially 80% in near future.

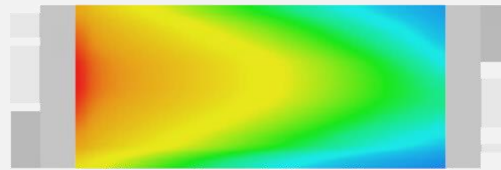
Super Fast Simulation Results with AI Surrogate Models

Successfully Applied:

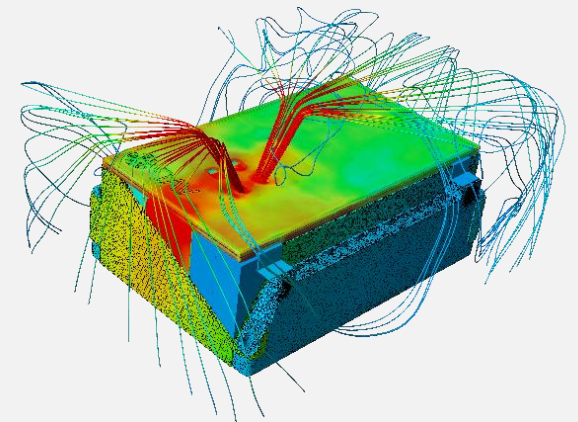
H2 ICE piston design



Fuel cell degradation

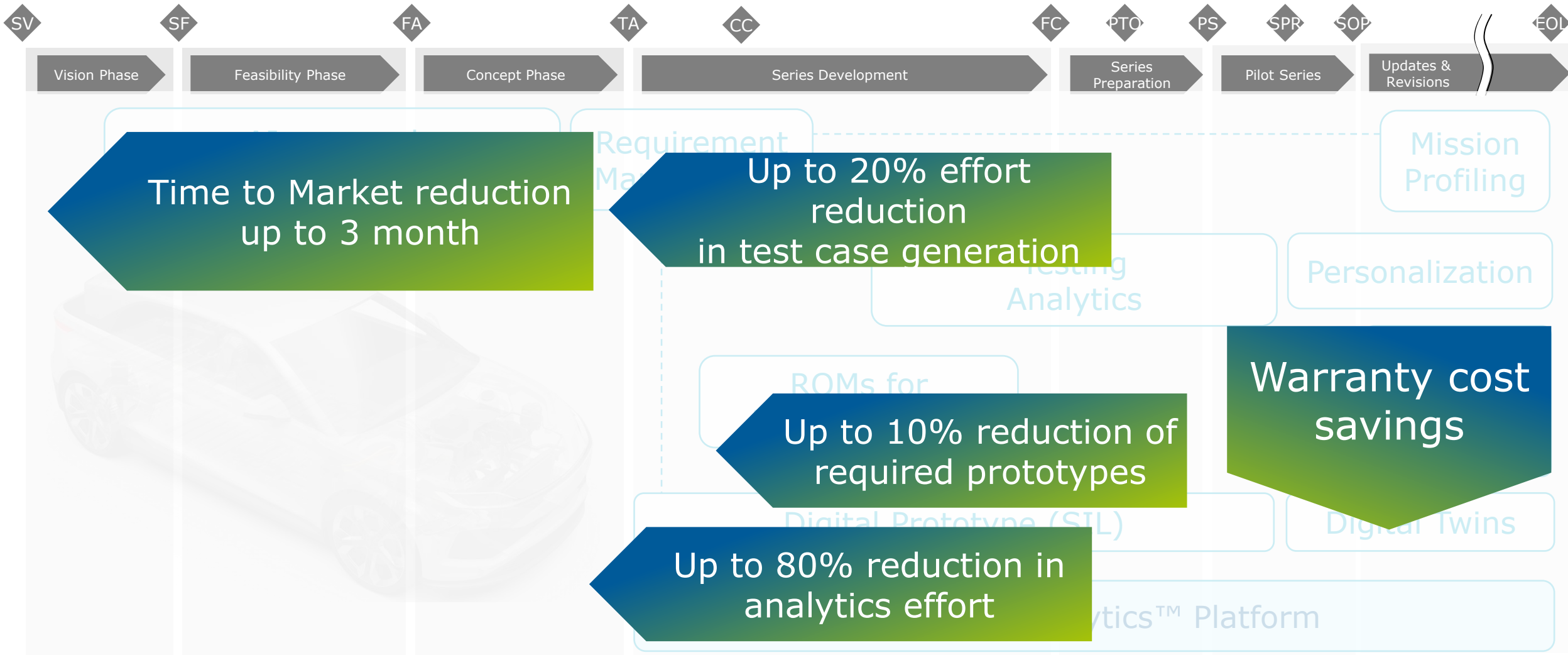


Battery thermal propagation

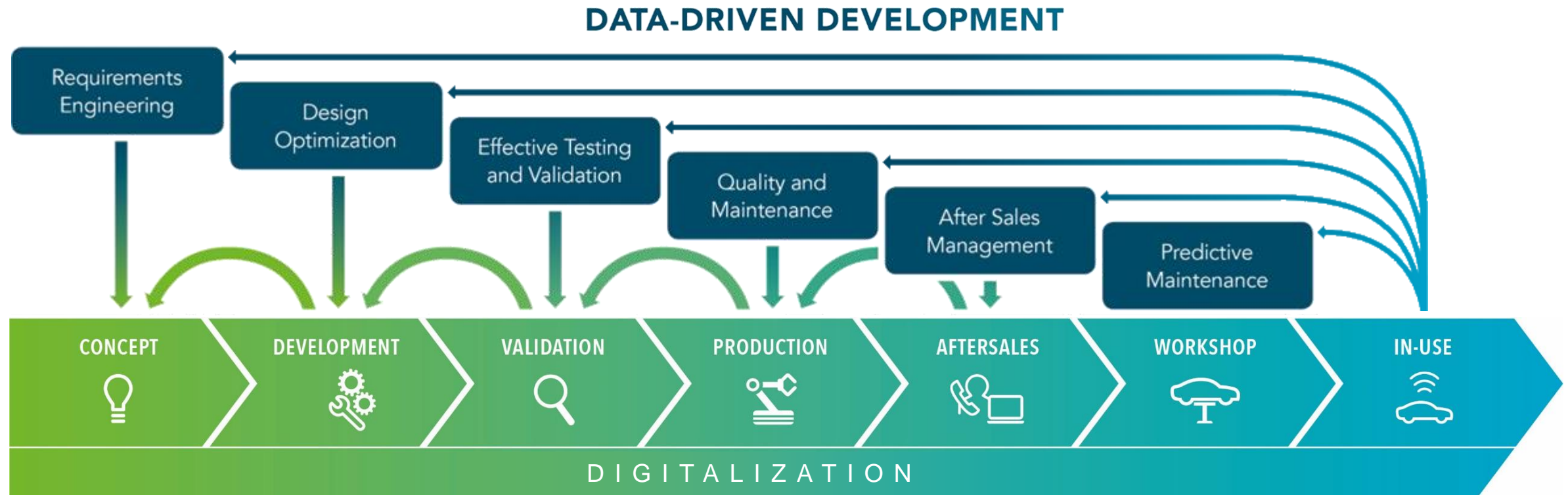


Significant performance improvement → with **240x** speedup; 1min reduced to 0.25s
Optimization cycles with customizable objectives and constraints → with **35x** speedup;
70hrs reduced to 2hrs

Summary: Benefits of Artificial Intelligence Applications



Outlook – Connected Data feedback into engineering



Thank you



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