SYSTEM VIRTUALIZATION FOR EVALUATING SAFETY CRITICAL FUNCTIONS USING CREDIBLE SIMULATION APPROACH

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Example of missing Feature in ADAS / Robotaxi

Edited from original YouTube source, channel: Elektrisiert, published on 24th Jul 2024

“Wie gut fahren Robotaxis OHNE Taxifahrer in USA”

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Feature Development

How to develop, integrate and test the missing Feature in an efficient way?

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Credibility as a basis for trust in engineering

Standards & Collaboration

Speed

Trust by Credibility

Capabilities

Simulation & Virtualization

Safety & Compliance

Flexibility & Consistency

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What is a Feature ?

- *For the System Engineer in us …*
  A feature is “an abstract functional characteristic of a system of interest that end-users and other stakeholders can understand.”
  [ISO/IEC 26550:2015]

- *For the Businessman in us …*
  A Feature is a **stakeholder perceivable behavior** of a system which has **positive impact on his purchasing decision**.

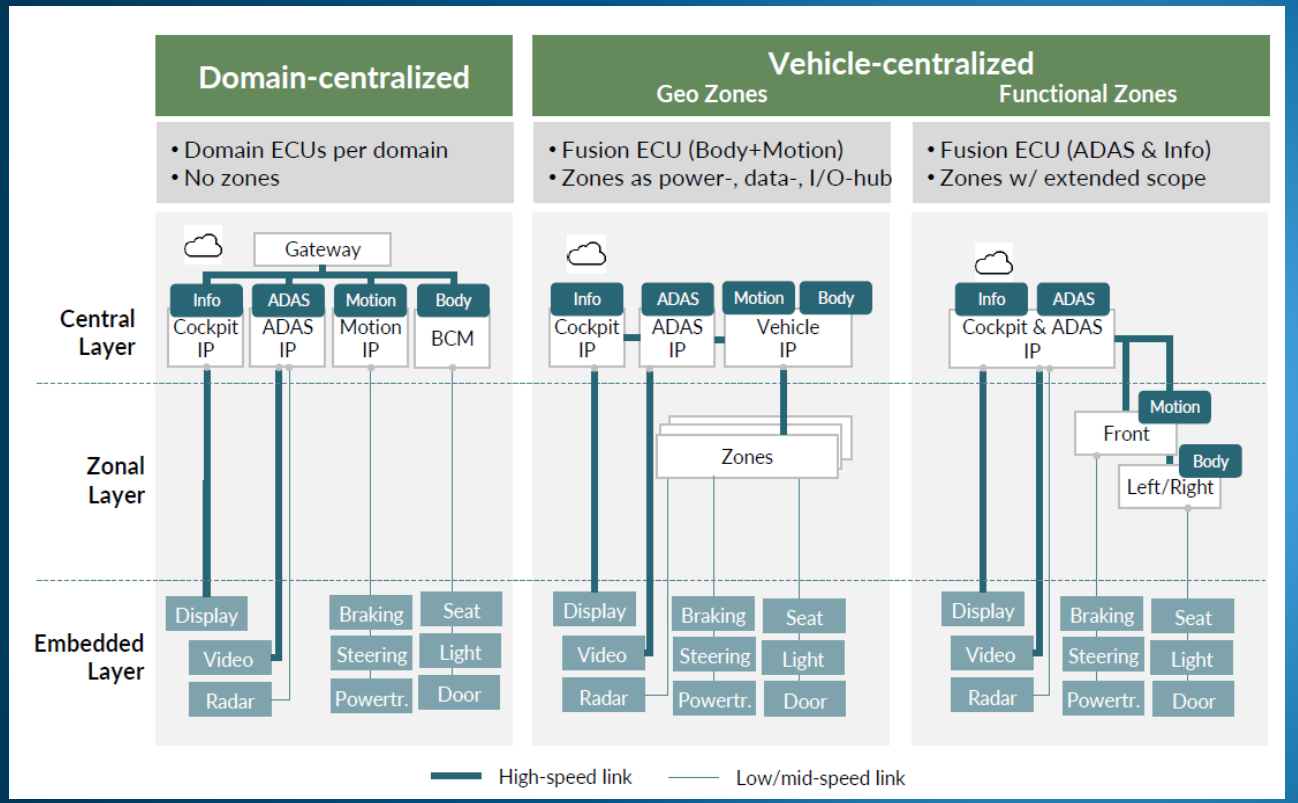
- A feature describes a system’s behavior, **not a (technical) system solution!**

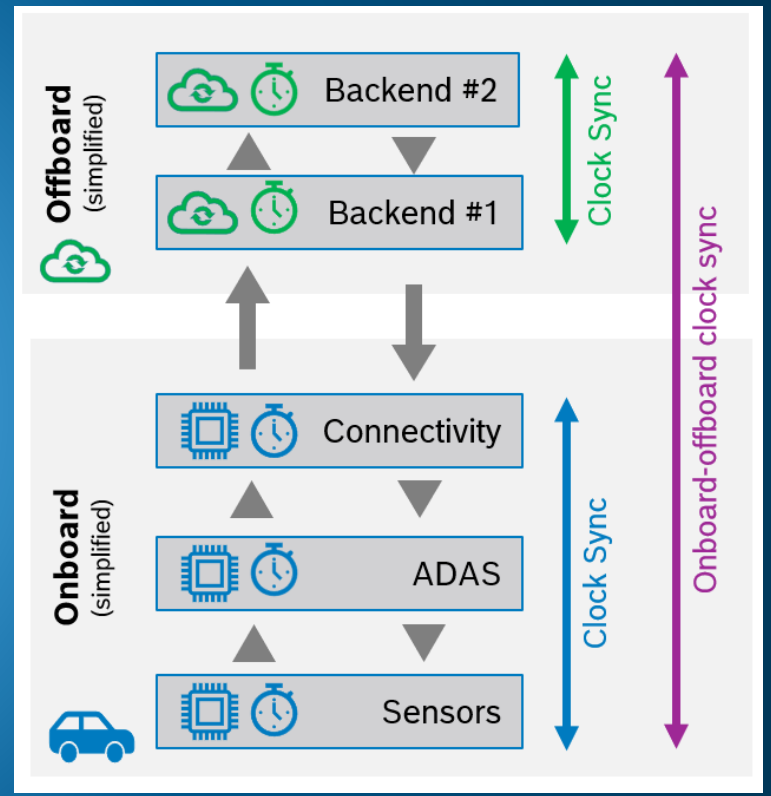
Source: Volkswagen

“When I approach my car with a box in my hands, I want to be able to open the trunk without having to put the box down.”

Features have positive impact on stakeholders´ purchasing decisions
and are as a matter of principle independent from their technical realization in the Mobility System

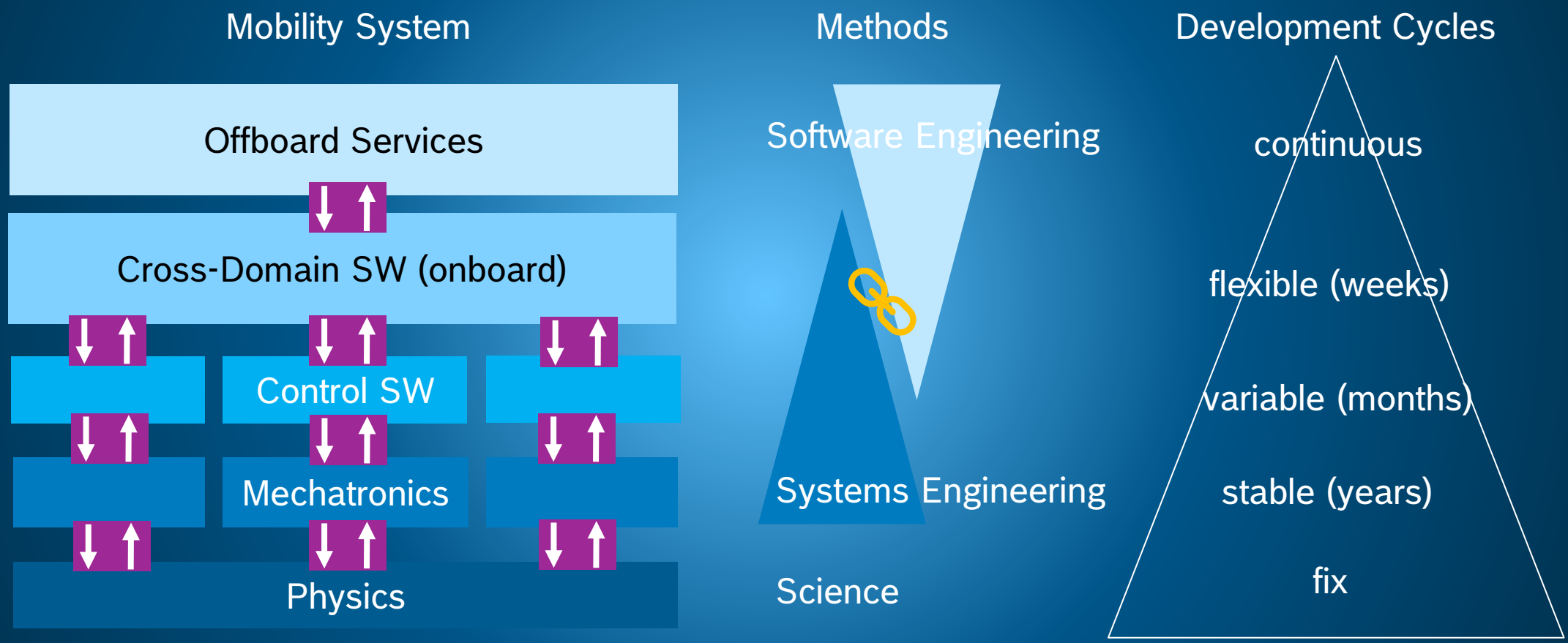
Challenges in Feature Development





Unclear mainstream in EEA, different market behaviour and RDS distribution as challenge and driver for flexibility

Combining stable foundations with flexible Features



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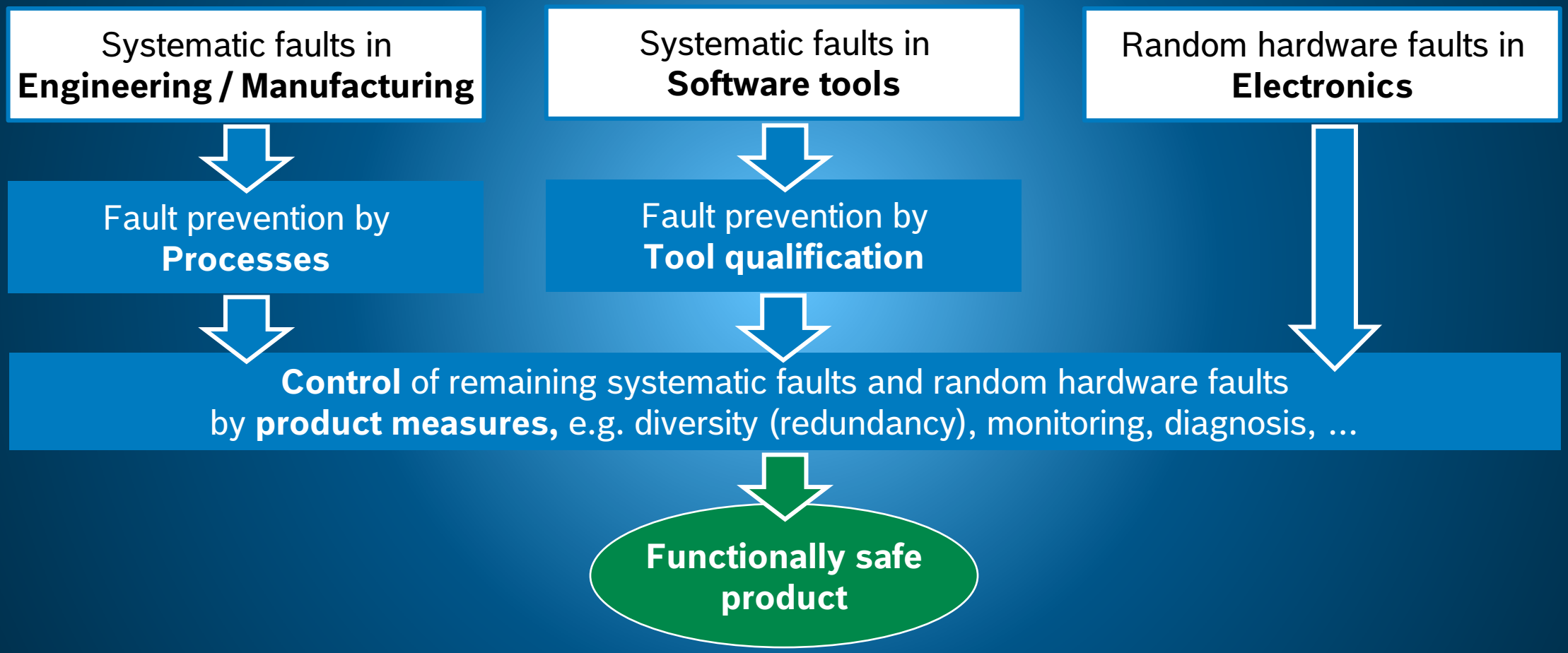
Design for Safety

http://www.nexthamburg.de/userpost/klothoiden-und-schleppkurvenberechnung-beim-radwegebau/

https://www.telegraph.co.uk/news/newstopics/howaboutthat/7547129/Council-condemned-over-Britains-shortest-cycle-lane.html

Safety cannot be implemented afterwards!

Safety objectives and measures



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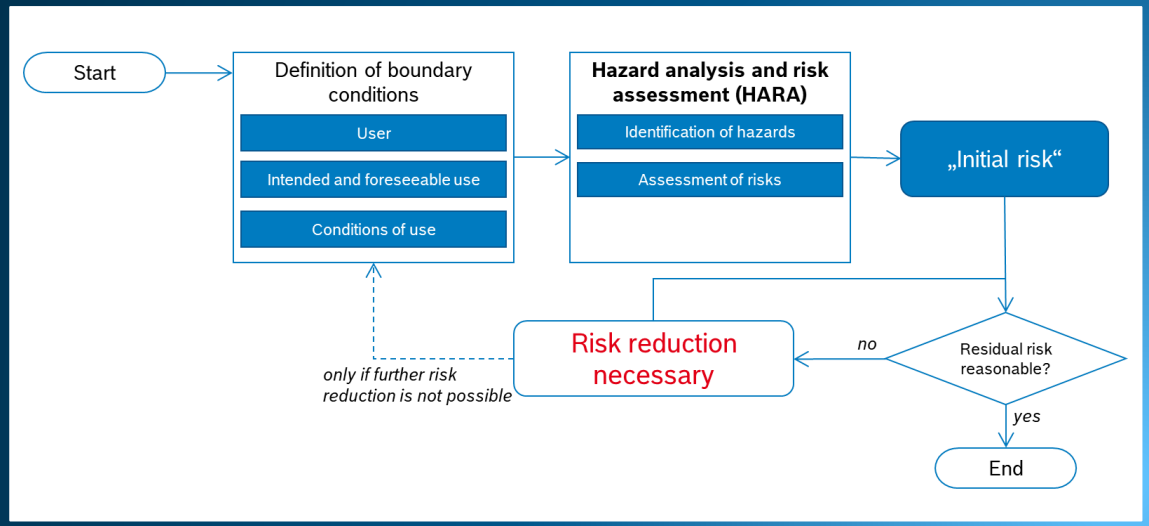
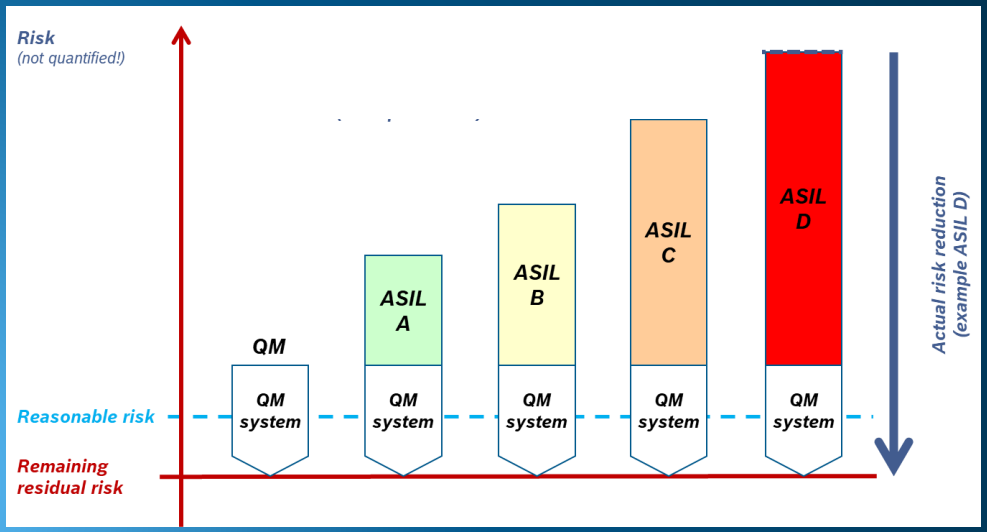
Hazard Analysis and Risk Assessment (HARA)





- Since the endangerment of the user (driver, passenger, other road users) has its origin in the vehicle, the **top-level safety requirements** (= safety goals) are determined on **vehicle level**.
- The necessary amount of implementation measures are determined in a **risk-based approach**.
- According to the system design, the safety goals broken down to **safety requirements allocated to elements on sub-system level** (hardware, software, cloud, etc.)

Safety is implemented using a risk-based top-down approach!

ASIL = Automotive Safety Integrity Level = necessary amount of risk reduction measures according to ISO 26262

For QM classified safety goals the implementation according to a standard Quality Management System (e.g. IATF16949) provides sufficient risk reduction.

Example: Derivation of Safety Goals / Safety Requirements from HARA

Safety Goal
“No transition of driving task to driver during driving”

- Vehicle in safe state
  - L4 system brings to the vehicle into safe position
  - L4 systems allows safe change of driver from passenger seat to driver seat → switch on warning lights
- Driver must be suitable and ready for take over of driving task
  - authentication via driving license
  - pressed brake pedal to enable start of driving

Residual risk that something happens anyway; 100% safety not possible!

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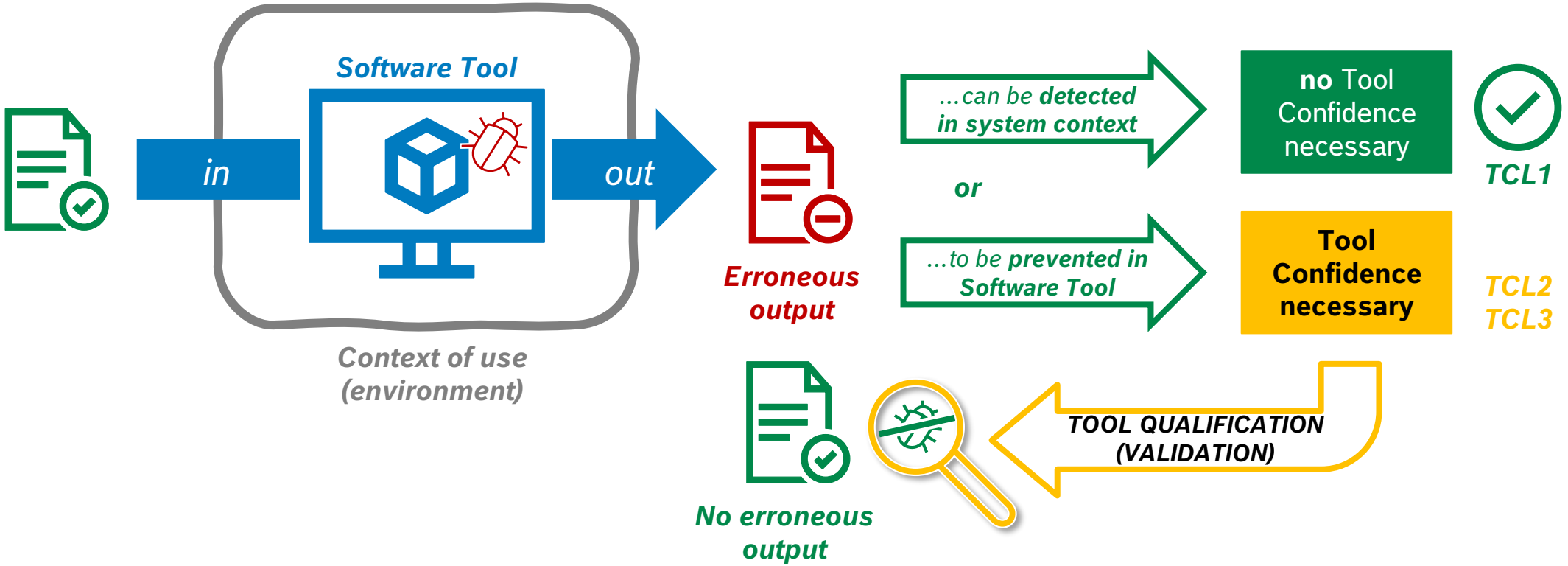
Confidence (Trust) in the use of Software Tools



Tool vendor can support Tool Confidence by pre-qualification of standard use-cases!

TCL = Tool Confidence Level = required level of confidence in a tool feature according to ISO 26262

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Example: Hardware & Software Interface Standardization in China

Standardizing
automotive interfaces Hardware & Software

- Connectors & Cables
- CAN, Lin, Flexray
- Ethernet, TSN, K-wire
- WLAN, Bluetooth, ...

NTCAS 汽 标 委

Standard items	**Standard type**
Physical electrical interface	
Connectors and cables for data transmission	
QC/T road vehicle bandwith to 10 GHz shielded balanced cable	Row standard
GB/T road vehicle 50Q impedance RF connection system	National standard
many more	
Communication Protocol Interface	
Cable Communication Protocol	
GB/T on-road vehicle Ethernet	National standard
GB/T 41588 CAN	National standard
many more	
Logical semantics & Device Service Interface	
Intelligent driving range	
GB/T vehicle self-driving sensor interface with data fusion unit	National standard
Intelligent driving area equipment service interface specification	National standard
many more	

NTCAS: National Technical Committee of Auto Standardization

Collaboration in Ecosystems

Our products require **cross-domain** and **cross-ecosystem** product development approaches.

We **collaborate** with the right development partners on the basis of trust and standards.

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It‘s a all about people and collaboration…

Wesley L. Harris
Charles Stark Draper Professor of Aeronatuics and Astronautics, Massachusetts Institute of Technology

> “All of this [progress] happens because of people – this is not a solo journey!

“A Half-Century of Research and Mentoring in Fluid Dynamics from Hemodynamics to Hypersonics”
Keynote at NAFEMS World Congress 2023, Tampa, FL.

NWC23
NAFEMS WORLD CONGRESS
A WORLD OF ENGINEERING SIMULATION
15-18 May 2023 Tampa | Florida | USA

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Capabilities are essential for trust in engineering

Capabilities

Highly qualified people/organizations are an indispensable element in achieving business excellence.

We develop special qualification measures for new key technologies in collaboration with universities and institutes.

People Qualification Measures

As an example, the Virtual Engineering Qualification Program covers topics such as credibility of simulation, engineering traceability, PLM and more.

To achieve business excellence, several aspects are important. Capability is one of the essentials!

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The role of simulation in product engineering

Numerical Simulation

... will be a **game changer** in product engineering if used for **virtual release**

... is a **powerful approach** to

- *speed up development*
- *save costs*
- *explore new business areas, where real testing is rather impossible (e.g. autonomous driving)*

Trust

... in M&S results will be the **key enabler**

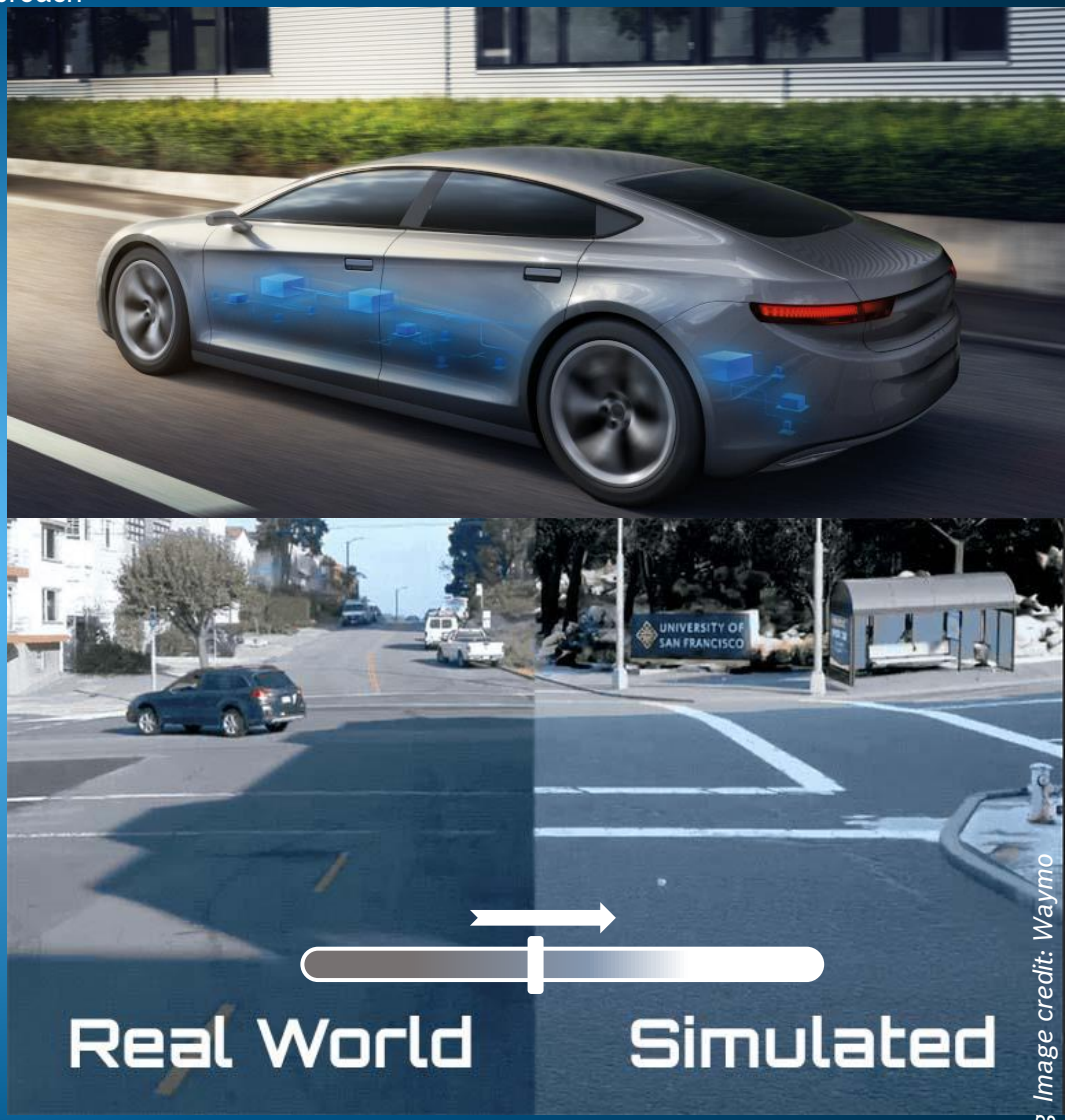

Image credit: Waymo

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Use Case: Rating of cars by NCAP foundation, simulation of NCAP scenarios

Paradigm shift in virtualization

From **“Supporting”** to **“Leading”**

Partly seen as a supplement to the development process, often focused on physical testing

Mastering new challenges and priorities to be prepared for the future:

- **Ability to react quickly to changes in requirements (product, business, legislation), e.g.**
- **Reducing dependency on physical tests**
- **Mastering issues that are hardly economically feasible by physical testing**

⇨ Ensure future competitiveness

Situation EURO NCAP 2026:

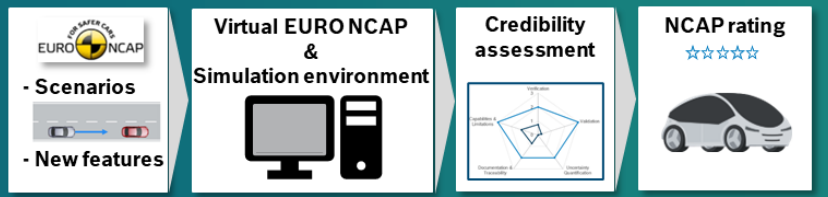
Test on test tracks are reaching their limits.

Besides known tests, there are further investigations into crash avoidance and additional NCAP scenarios.

UN Regulations: Reliable virtual methods will be permitted in this context

Approach:

Virtualization & Credible Simulation of the relevant scenarios for NCAP rating



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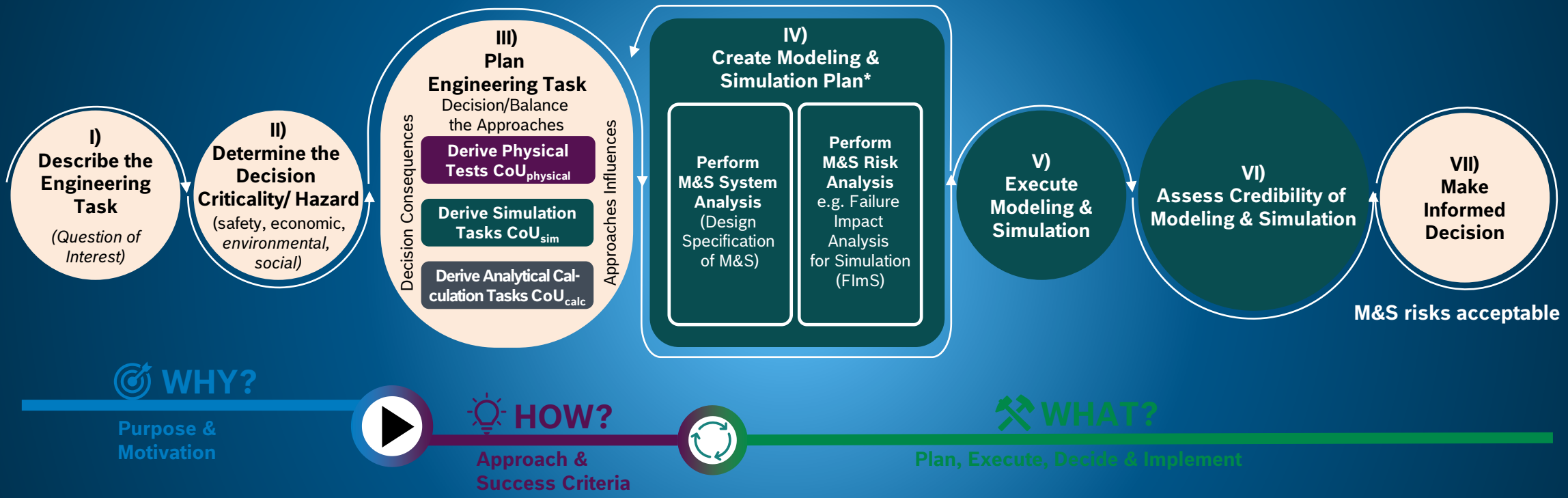
The Robert Bosch Credibility of Simulation Framework



Enabling systematic, transparent and comprehensible informed decision-making by credible simulation models and results

Feature Development in virtual Environment w/ IPG CarMaker: Scenario recreation

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Feature Development in virtual Environment w/ IPG CarMaker: **Demo**

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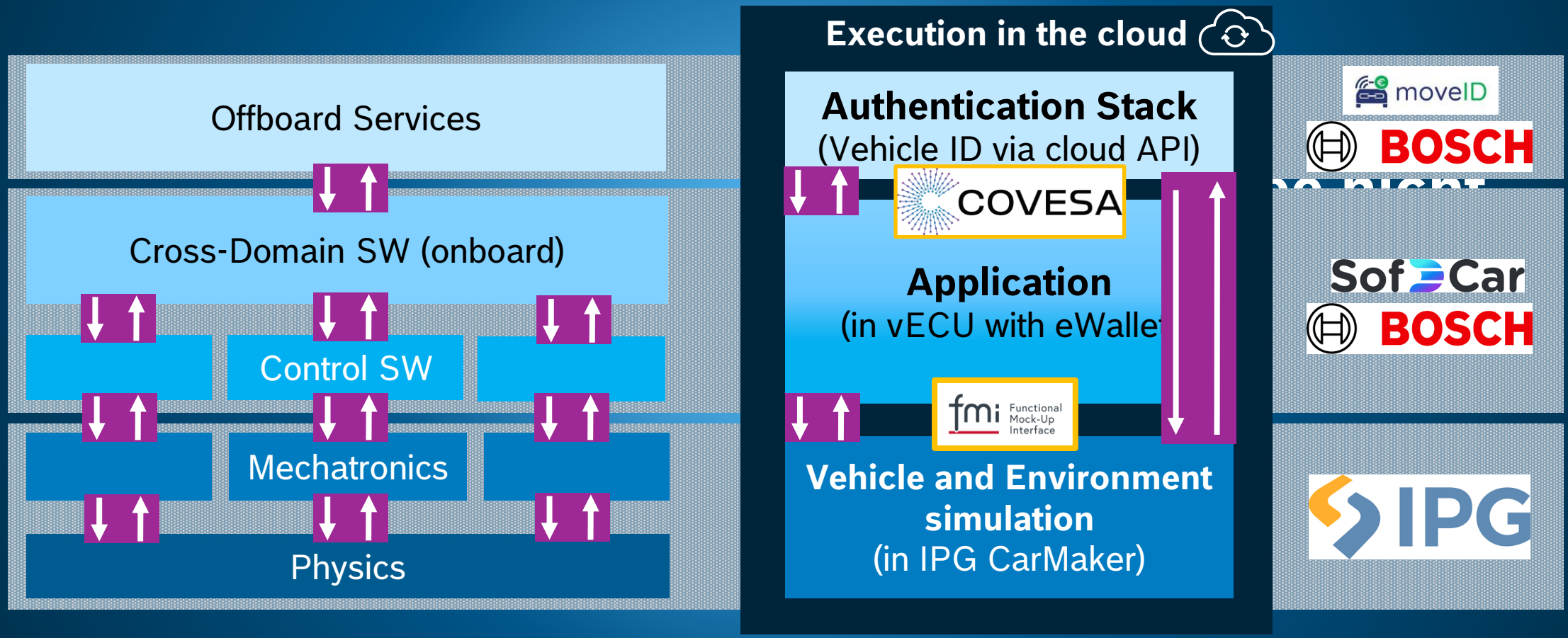
Feature Development in virtual Environment w/ IPG CarMaker: **Overview**



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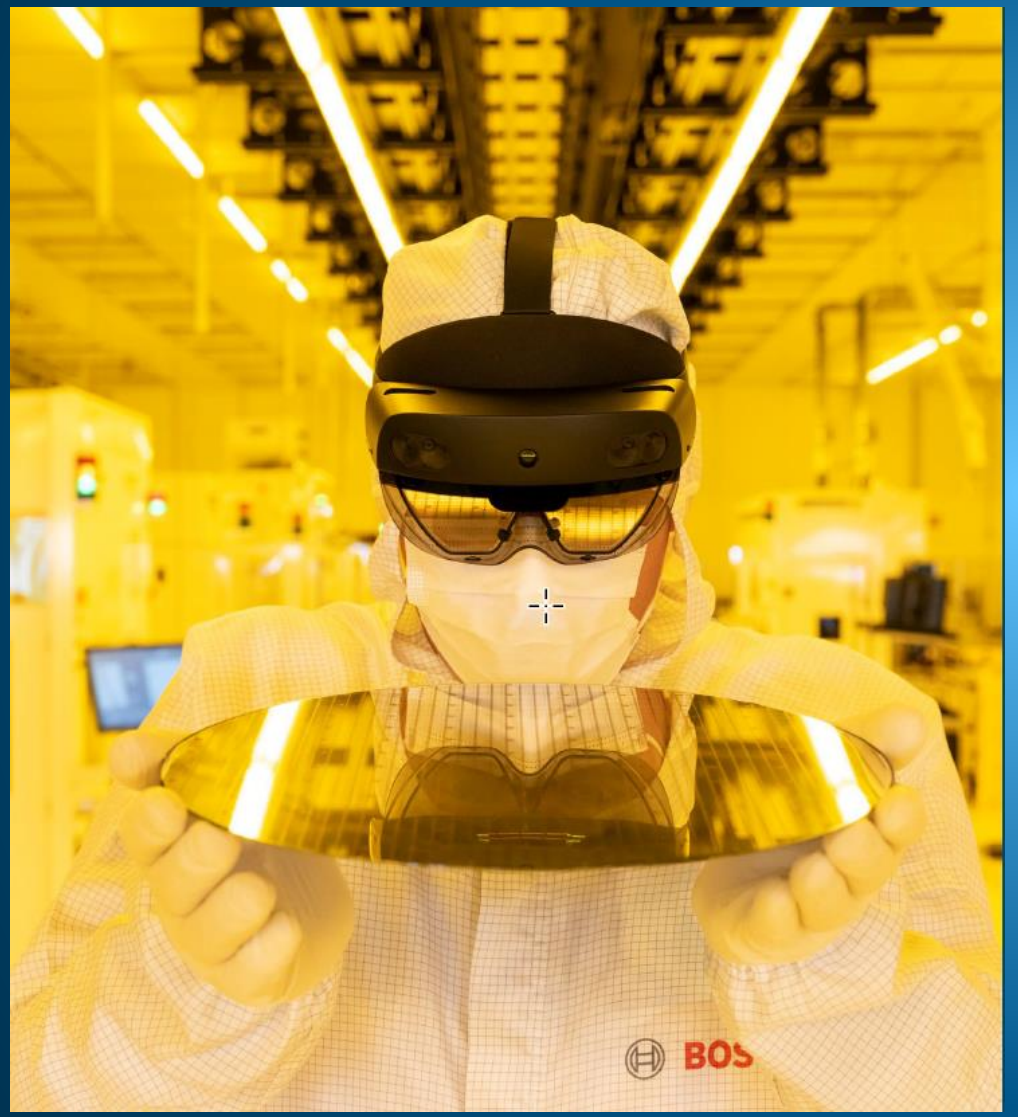

THANK YOU!!!