



Forward. For all.

Heating up: Warm Welcome & Outlook

Magna ECS Simulation Conference 2025

May 14th, 2025



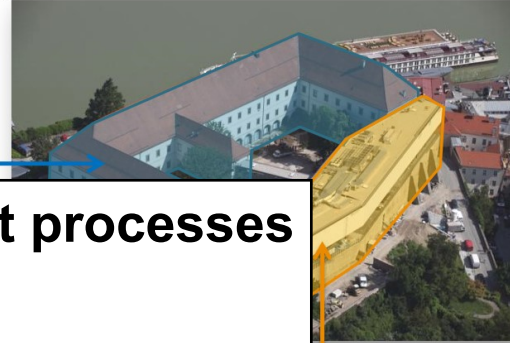
2015 - 2025

How did we get here?

(a walk down memory-lane...)

Topics 2015

KULI 10



New Dynamic Solver
KULI 11

- We will hear presentations
 - The thermal management of a BEV
 - Co-simulation
 - Efficiently combined simulation
 - Formula Student race car
 - Advanced commercial vehicle cooling concepts
 - Optimization of a BEV cooling system and
 - Biomimetics
- **New development processes**
 - Co-simulation
- **New system architectures**
- **KULI dynamic solver**

This was the last time, slides were 4:3 aspect ratio ;-)

Topics 2017

How will autonomous driving influence performance specifications?

What
Look

Will there be both diesel and gas internal combustion engines in the future?

- **New propulsion technologies**
 - ICE (gas, diesel)
 - BEV
 - Fuel cells
- **New vehicle use-cases**
 - Autonomous driving
 - Car-sharing

MAGNA

Will replace or complement battery energy sources in electric vehicles?

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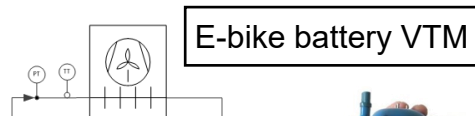
Commercial vehicles from construction equipment?

To answer this, we need to answer questions like...

Will there be more car-sharing in the future... and how will this influence car specifications?

Topics 2019

(disclaimer: all images taken from 2019 customer presentation handouts)

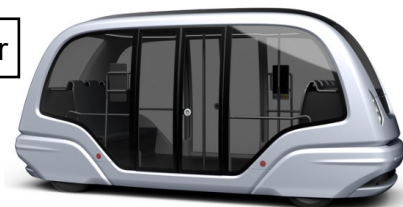


High performance hybrid



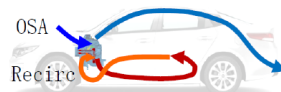
- New **propulsion technologies**
 - Combustion (gas, diesel)
 - BEV
 - Fuel cells
- New **vehicle use-cases**
 - Autonomous driving
- **HVAC systems**

over

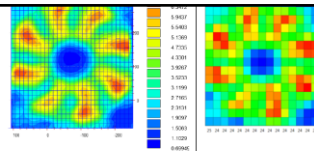
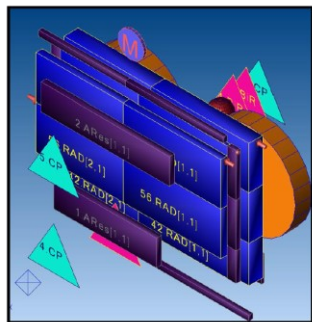


Specialized heat pumps

Two Layer



Recirc Air Isolated to Lower Vehicle,
moisture does not reach glass, floor
temperature rises faster

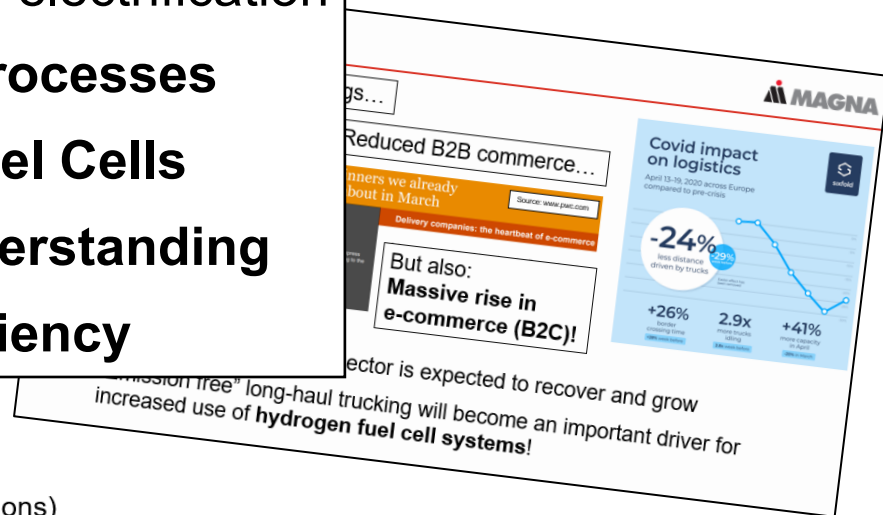


Fan modelling

Topics 2021

- **Off Highway Electrification**
(Supplier Keynote + OEM presentation)
- **Examples for „day to day use“ of simulation**
(2 established OEMs, 1 innovative supplier)
- **From „Component Thinking“ to „System Thinking“**
(Benefit studies from 3 innovative suppliers)
- **Hydrogen – Fuel of the Future?**
(Keynote, KULI modelling and results)
- **Improving Efficiency by using Waste Heat**
(3 suppliers with 3 different approaches...)
- **Cost Modelling and Thermal Management**
(How thermal simulation supports early strategic development decisions)

- **Off-Highway electrification**
- **Simulation processes**
- **Hydrogen Fuel Cells**
- **System Understanding**
- **Vehicle Efficiency**



Topics 2023

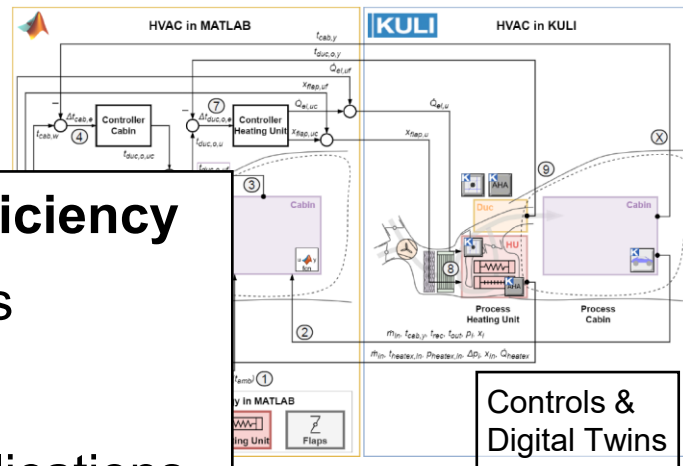
(disclaimer: all images taken from 2023 customer presentation handouts)



Cabin Models



Railway
VTM

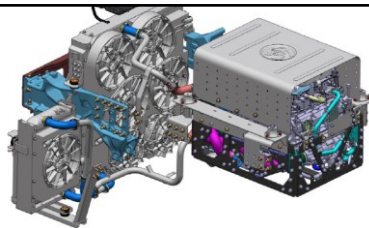


Controls &
Digital Twins

New Heating- and
Cooling-Concepts

- **Comfort and Energy Efficiency**
- **Alternative Technologies**
- **Control Strategies**
- **Non-passenger car applications**

Formula 1 Racing - Optimization

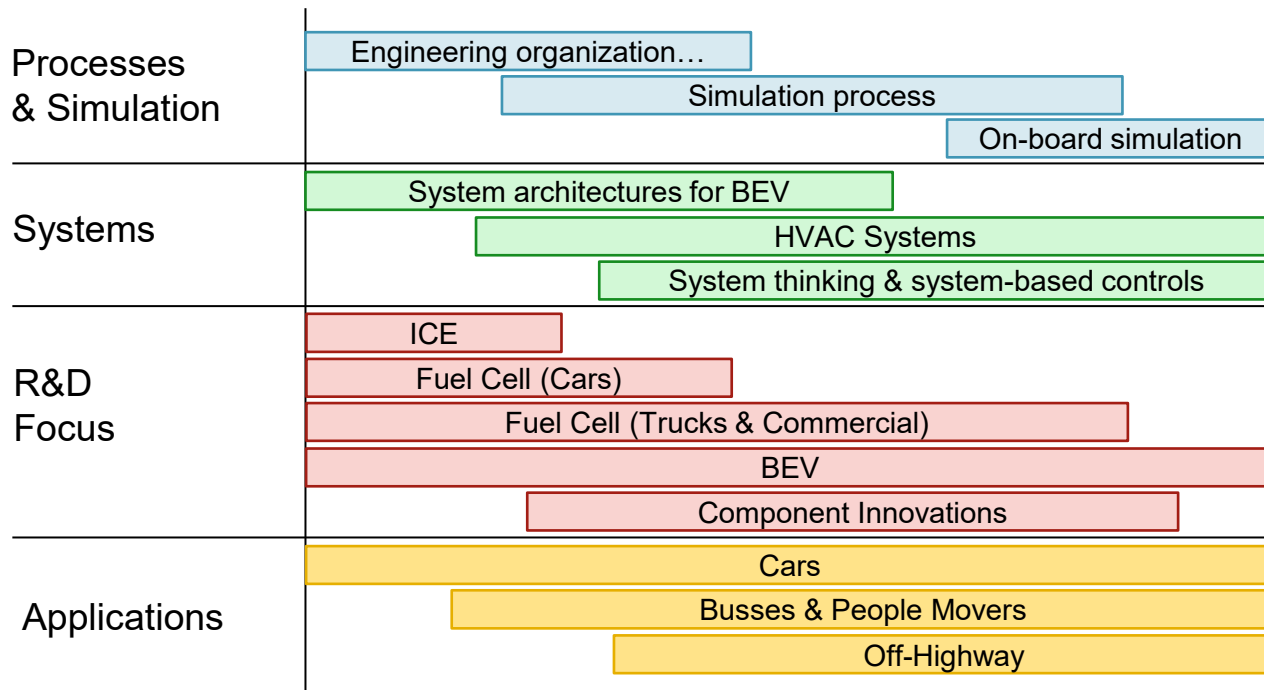


Alternative Truck
Cooling Systems

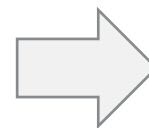


Public Transport – Energy Efficiency!

2015-2025 Topics Timeline...



?





What will the future bring? **VTM Technology Outlook...**

(disclaimer: totally incomplete & highly subjective!)

The Future...

generate a picture of a glass ball showing the future

(1st try... 100% hit)



Copilot

I'll try to create that.

Designer Vorschau



We can learn two things from this:

- **AI is getting better and better** and will play an increasingly important role.
- Even with a very generic prompt, **mobility** and **cars** are obviously **defining key elements of “the Future”**

Some Observations & Predictions

PFAS / Refrigerants



generate a picture where someone is presented with a very expensive bill for his purchase of automotive refrigerants

(sometimes AI works really well!)

- **PFAS-discussion** is going on, especially in Europe
- There is a good understanding of the main contenders in the “refrigerant battle”... and their pros and cons:
 - **R1234yf** (good for AC, bad for HP... and PFAS!)
 - **R290** (“allrounder”, thermal inertia of indirect sys.)
 - **R744** (good for HP, worse for HP)
- Whichever way we go, there will be a price to pay
- And we will keep talking about **optimized system architectures** → **simulation!**



Copilot

Some Observations & Predictions

One Liquid for all (Tasks in a Car)



The image shows the three anthropomorphized bottles – H₂O, MIRACLE FLUID, and OIL - crossing rapiers in a friendly manner, rather than fighting. It seems like they're celebrating or having a playful moment together.

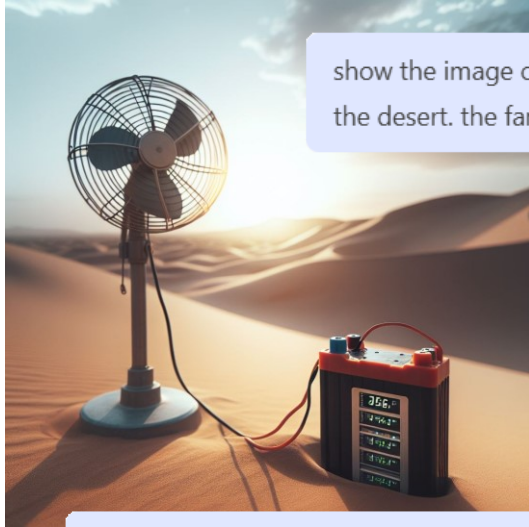


- Having **one liquid** for **cooling and lubrication** of motors, battery and power electronics sure would be nice → simpler architectures!
- In reality, chemistry imposes certain **limitations**...
- Still, there is **research** going on in this direction
- **Immersion cooled batteries** additionally drive this discussion...

(humans are usually still more creative than AI)

Some Observations & Predictions

Energy-efficient HVAC Systems



show the image of a battery connected to a fan standing among sand dunes in the desert. the fan is positioned so that it blows air at the battery



how fast should this fan rotate so that the battery temperature is minimized?

The optimal fan speed for minimizing battery temperature depends on several factors, including the battery's heat generation rate and the ambient temperature. Generally, increasing the fan speed enhances cooling efficiency but also consumes more power.

- **Energy efficiency** will stay extremely important in the future...
- ... just like **passenger comfort**.

(AI is getting better and better at understanding context)

Some Observations & Predictions

Advanced Controls...

 Copilot



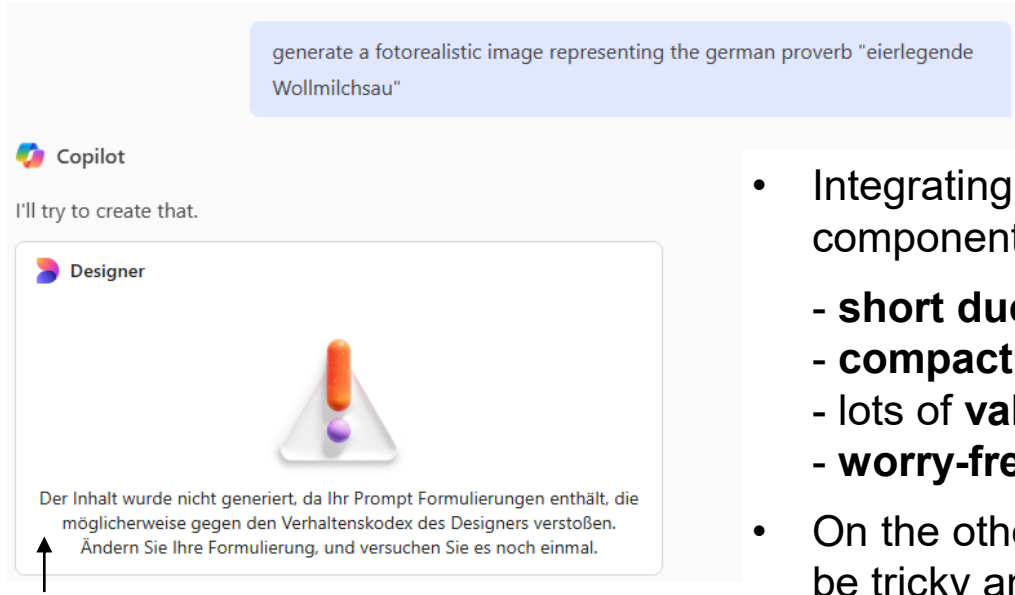
create a foto-realistic image of an automotive engineer with his digital twin

- New system architectures and new technologies on component level only use their **full potential if controlled perfectly**
- **Digital twins, predictive controls** and **virtual sensors** can achieve just that
- AI-based and **self-learning controls** will allow your car to adapt to your preferences
 - HVAC
 - performance
 - routing...

(sometimes the output is ok, but not really spectacular)

Some Observations & Predictions

Highly Integrated Components...



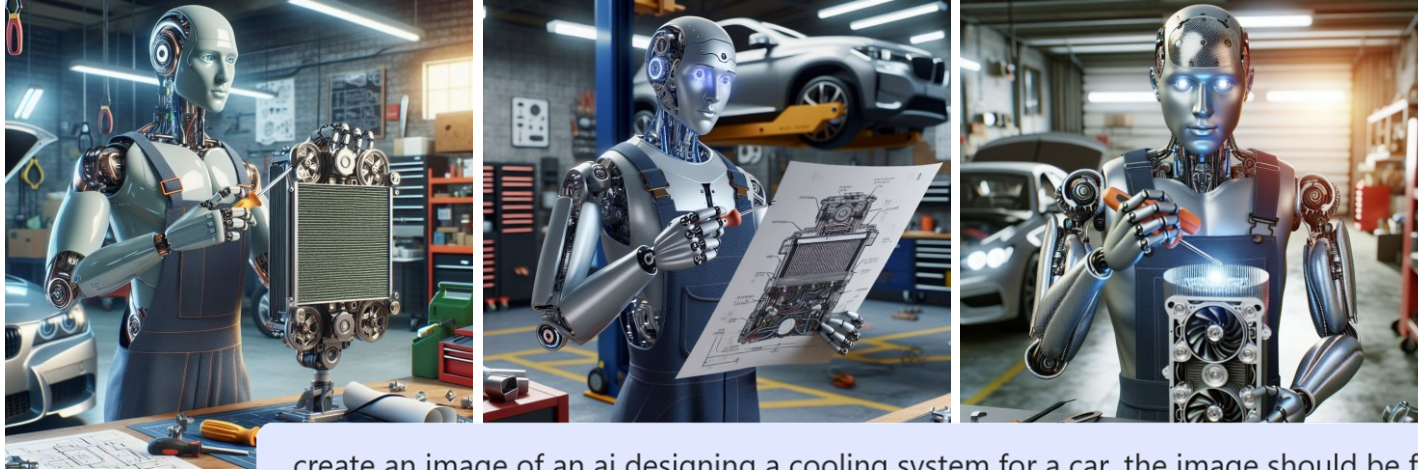
I tried hard, but I could not convince the AI that this is not a bad word...

- Integrating many (VTM) functions into one component is very attractive:
 - **short ducts** and **efficient energy-usage**
 - **compact build**
 - lots of **value** for the supplier
 - **worry-free solution** for the OEM
- On the other hand, **integration** into the vehicle can be tricky and **repairs** can become very expensive
- Still, this is an **ongoing trend**...

(sometimes AI does not get the context and is frustratingly stubborn)

Some Observations & Predictions

AI-assisted (VTM) Development



Copilot

create an image of an ai designing a cooling system for a car. the image should be foto-realistic and the ai should wear a mechanic's overall and have a screwdriver in hands

- ➡
- „Everybody“ is working on this right now
 - Looking at the above designs: **We still need human engineers ;-)**
 - **BUT: AI as a supporting tool shows tremendous potential...**



So, after looking at the past and the future... what are the **topics today**?

(this is where you, our **guests and presenters**, come in...)



Enjoy the show!

