



The Importance of a Virtual First Mindset in Engineering the Next Generation of Bentley Vehicles

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2024
ZERO PROTOTYPES
SUMMIT

Bentley's Push for a Virtual First Mindset

Context:

- The industry faces it's biggest change since the early **1900s** to Engineer the future of **EVs**.
- Growing competition from Chinese manufacturers highlights importance of **accelerated time to market**.
- **Increased complexity** of vehicles = more systems to test and validate



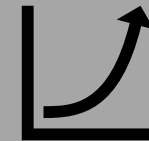
Mission:

- To navigate the transition to the generation of Electric Vehicles, **Virtual Development** toolsets must be strengthened within Bentley and the wider automotive industry across Europe.
- Innovative new virtual tools must be deployed within R&D and existing processes optimised to achieve reductions in time to market.



Strategy:

- Virtual tools must achieve 1 of 3 key pillars;
 - **Quicker** – Reduce time for iterations and enable earlier development
 - **Simpler** – Improve workflows and data exchange process
 - **Trusted** – Provide trust in new tools to increase confidence in Virtual Development



Automotive OEMs must Prioritise Investment into Developing Virtual Tools which are **Quicker, Simpler and Trusted**.



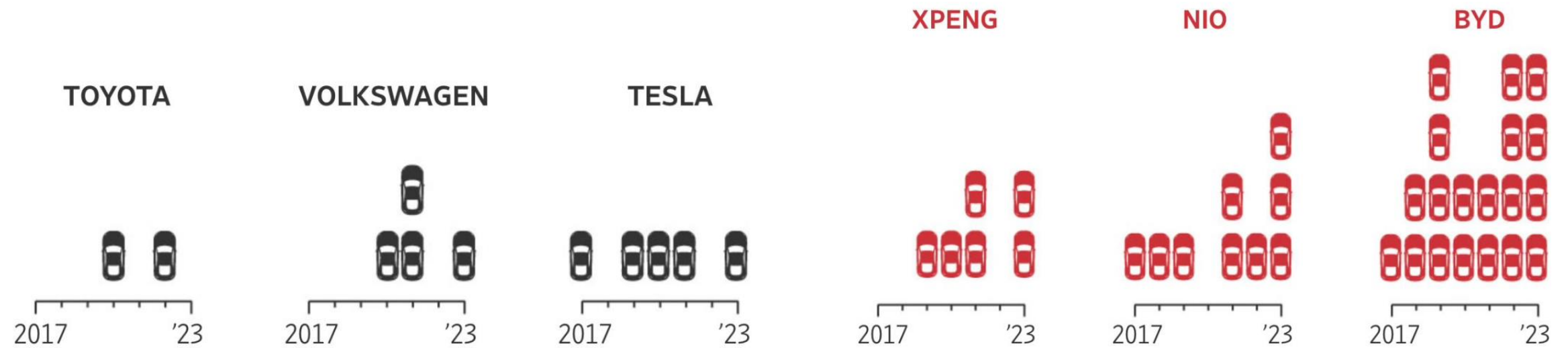
Beyond100

Bentley's path to sustainability

Bentley is on an extraordinary journey into the future. A future in which sustainability will be paramount. We have made significant leaps forward, from concept cars featuring electric powertrains to subsequent launches of Bentley hybrid vehicles. In fact two Bentley models are already available with hybrid powertrains: the Flying Spur Hybrid and Bentayga Hybrid.

Bentley will deliver its first 5 Electric Vehicles all within the next 10 years.

New and updated EV Releases in China



Source: X, Automobility

Chinese competitors are developing new cars quicker than established OEM's

Faster developer times can be achieved with the use of simulation...



Fundamental problems / issues discovered in this phase. Free to fix at this stage

Simulation technology and engineering judgement required to do this

Fine detail problems detected at this stage

The first physical prototypes should be available. High cost and low representativeness

Simulation must replace these

All change costs money at this stage

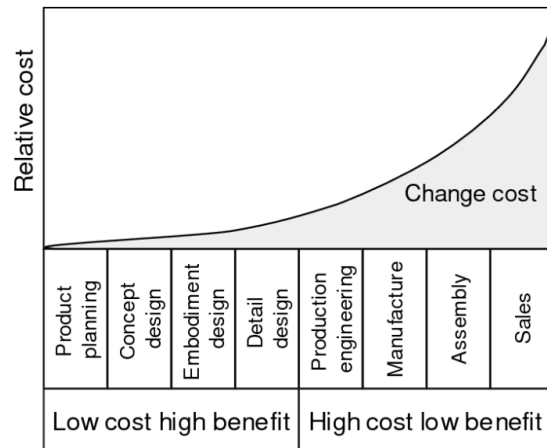
Simulation is required to rapidly iterate solutions and minimise changes required

Mature prototype cars exist at this point

The automotive culture is now focussed on physical test

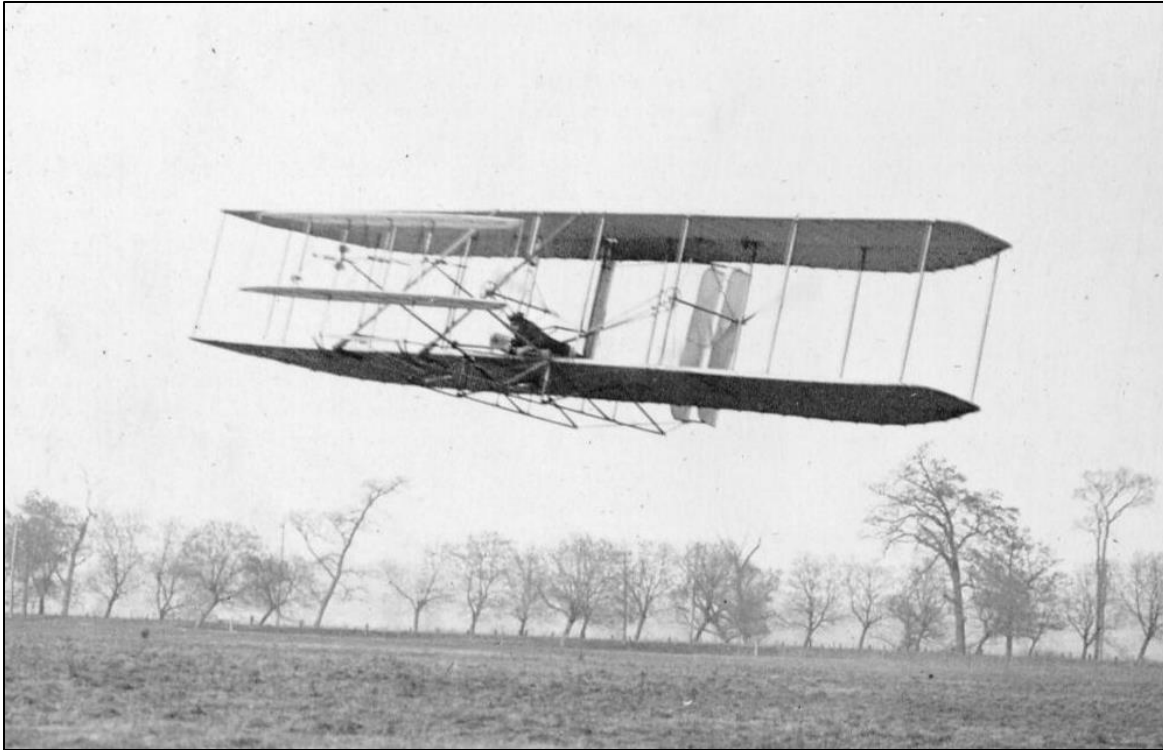
Mindset change is required for simulation to impact physical test at this point

Problem detection at this stage can be minimised by early use of simulation



Simulation tools can have the greatest impact at the early project stages when the data maturity is lowest

In the automotive industry the cost and accessibility of prototypes encourages their use...

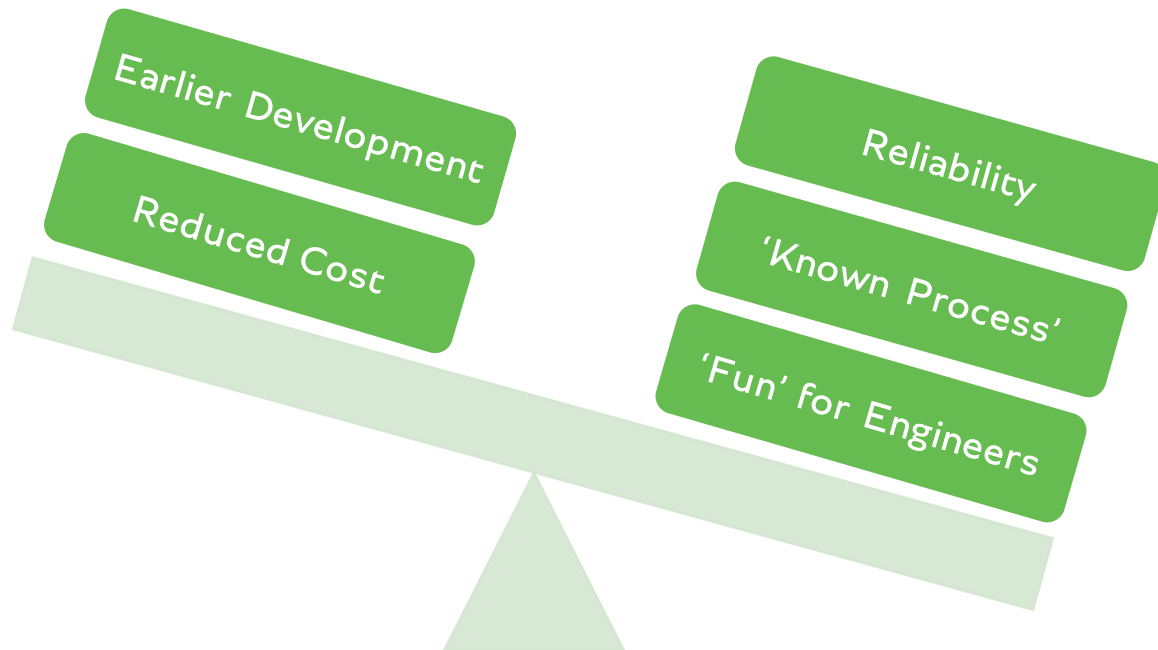


It is easy to rely on physical prototypes as an automotive OEM.

New technology must pass a higher bar / met a higher standard than existing technology

New Virtual Tools

Use of Existing
Physical Test
Methods



Virtual Tools must overcome;

- Concerns regarding **correlation** of a study
- **Inertia** provided by reluctance to change the process
- **Reluctance** from engineers to 'give up' their track time...

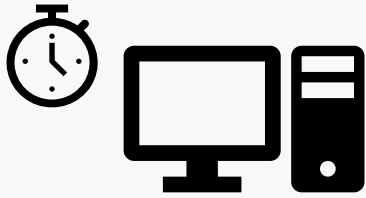
Virtual Strategy Engineers Must Strive to Provide Tools that Offset the Roadblocks of Implementation

What is required to enable greater use of simulation in the development of vehicles?

1. Quicker
2. Simpler
3. Trusted

The Impact of AI on Virtual Development

Implementation of AI + Machine Learning toolsets are being implemented to:



Drastically reduce computation times through application of machine learning tools.

'Lighthouse' use cases in Pedestrian Protection + Aerodynamics



Enable increased amount of styling proposals to be assessed- driving improved product quality



Provide an open interface workspace accessed by styling and CAE teams to provide rapid predictions based on proposed styling changes.

AI + Machine Learning tools applied in Pedestrian Protection + Aerodynamics for 2024

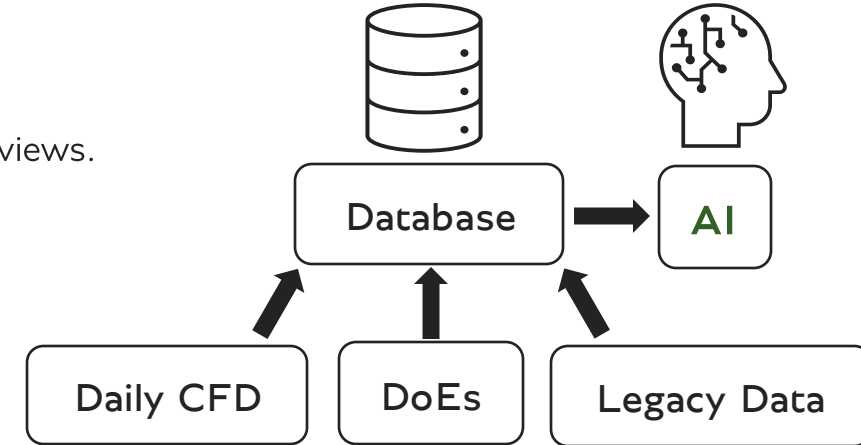
AI – An Aerodynamic case study from VWAG

Problem: Iterative loop between **design** and **aerodynamic computation**: 8h up to several days.

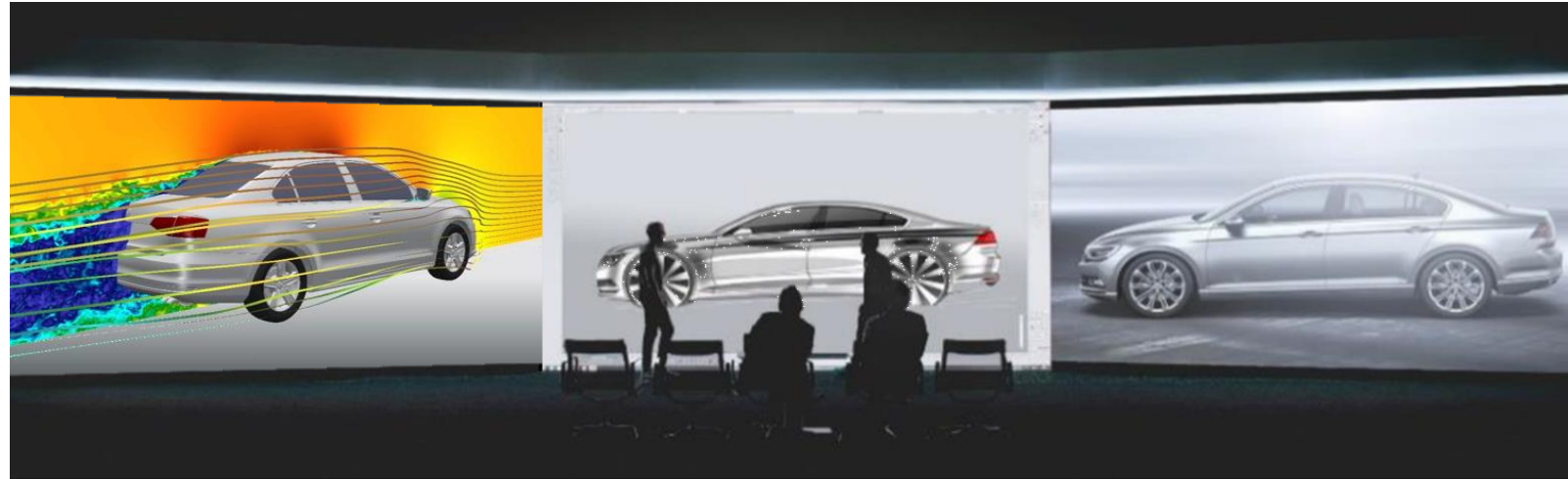
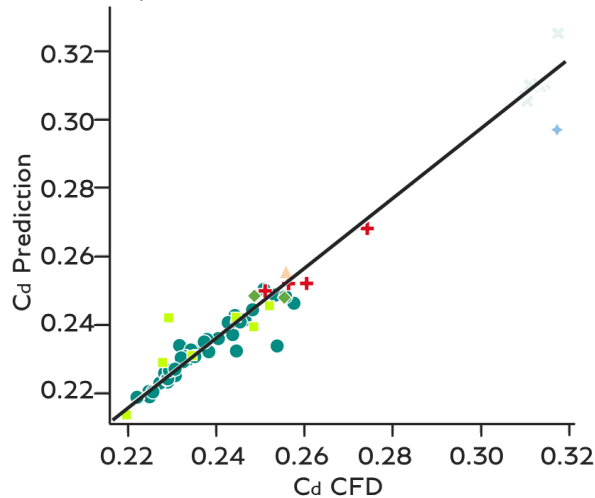
Solution: **Real-time** aerodynamic prediction and **interactive aerodynamic design**.

Key Benefit: Interfacing with **styling software** enables real-time aero results in working design reviews.

Hardware Training	Training Time [h]	Preprocessing time* [s]	Prediction time* [s]
1 x NVIDIA Tesla V100	~3	~30	~0.1



- Project 1
- Project 2
- Project 3
- ✕ Project 4
- ◆ Project 5
- ◆ Project 6
- ▲ Project 7



AI + Machine Learning tools applied in Aerodynamics at VW + Audi

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Software enabled car leads to a rise in electrical complexity which increases reliance on HiL testing...



To Be Commissioned By July 2024

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Driver-in-the-Loop (DiL) Simulators



Use Cases:

- Powertrain Noise Refinement
- Secondary Ride Comfort
- Road Noise Refinement

Developed by B&K + VI-grade

Until 2024, Bentley's only large DiL Capability was a static, Full Vehicle Simulator...

Driver-in-the-Loop (DiL) Simulators






BENTLEY

Press Information

BENTLEY'S DYNAMIC DRIVING SIMULATOR PROMISES A MORE SUSTAINABLE FUTURE

- **State-of-the-art simulator set to revolutionise Bentley research and development**
- **Compact in-house system will reduce the need for thousands of miles of real-world testing**
- **Potential to save 85 tonnes of CO₂ per vehicle prototype**
- **Bentley customers to benefit from an even more refined driving experience in the world's most sought-after luxury cars**

(Crewe, 2 May 2024) Bentley Motors today announced the company's new Compact Full Spectrum Driving Simulator, to be installed at its Dream Factory

NEWS - 2 MAY

BENTLEY MOTORS LTD. ELEVATES DIGITAL DEVELOPMENT WITH VI-GRADE'S COMPACT FSS SIMULATOR





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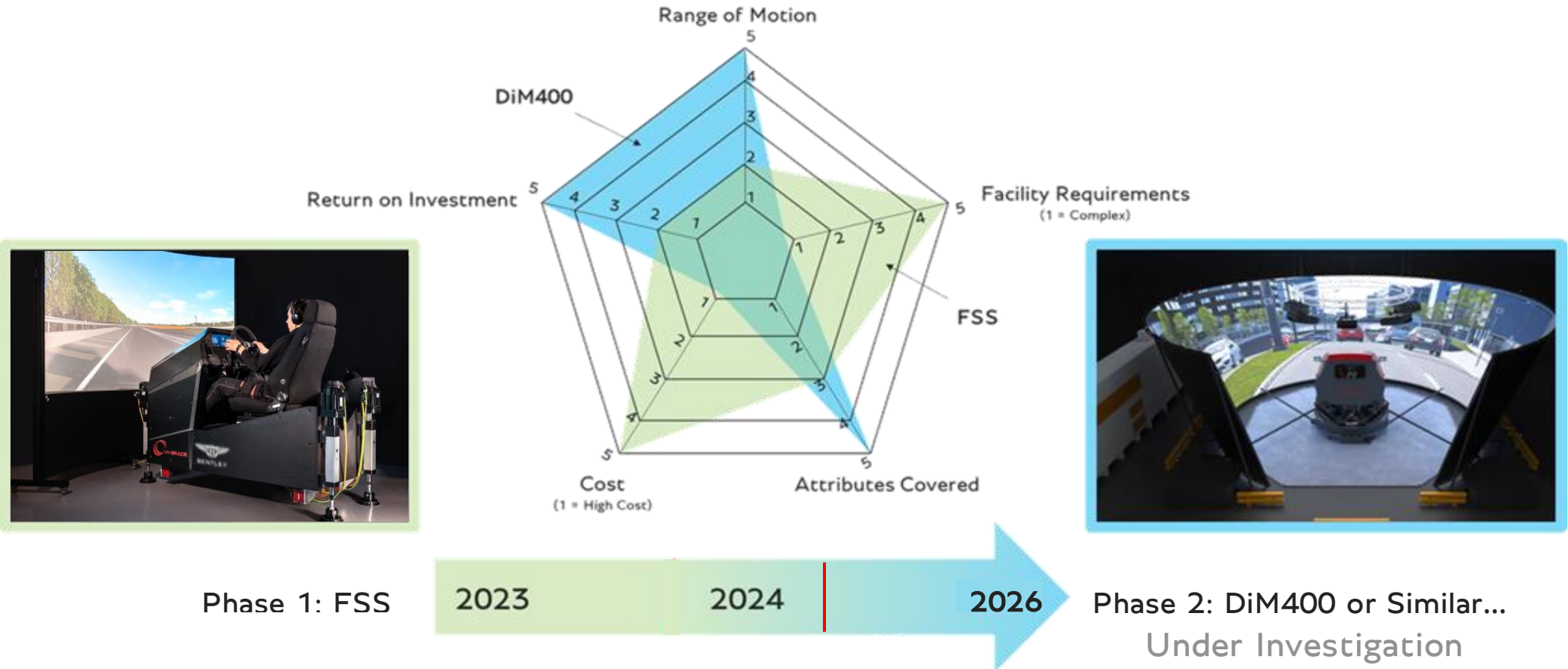


Bentley Introduces First Dynamic Driving Simulator On-Site

Bentley has pioneered innovation and digital development with the introduction of a state-of-the-art driving simulator at our Crewe site. Discover how this simulator revolutionizes vehicle testing, enhancing comfort, sustainability, and design precision.

Bentley Have Recently Announced the Purchase of a Compact FSS

Driver-in-the-Loop (DiL) Simulators



Compact FSS Forms Phase 1 of a Roadmap to Expand Portfolio of Driver-in-the-Loop Tools.



Thank you for your attention! – Any questions?

