Digital Credibility:

Testing by Simulation

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Who are Element Digital Engineering?

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The consultancy division of Element Materials Technology, a global test, inspection and certification business with 200 locations worldwide and 6000+ associates.

Deep specialists in the use of numerical analysis to support design, operational and safety challenges in high-hazard and capital-intensive industries.

Active participants in nationally-funded R&D programmes, collaborating with major software companies on developing new methods and techniques.

Developers of specialist software solutions for analysis and assessment problems that cannot be addressed with commercial codes.

Element in Digital Engineering

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- FEA, CFD, DEM, Corrosion Modelling
- Multiphysics & Mathematical Modelling
- Data Science and Machine Learning
- Asset Integrity Modelling
- Platforms for Digital Asset Management
- Software Development

Our Locations

- **Derby**, UK - Headquarters
  - Historic Darley Abbey Mills
- **Bristol**, UK
  - Historic-quarter of city centre
- **Cambridge**, UK
  - On the world-leading Cambridge Science Park
- **Houston**, USA
- 40 full-time employees – specialists in
  - Engineering integrity
  - Process simulation
  - Safety analysis
  - Can also draw on large pool of skilled associates

Smarter Testing

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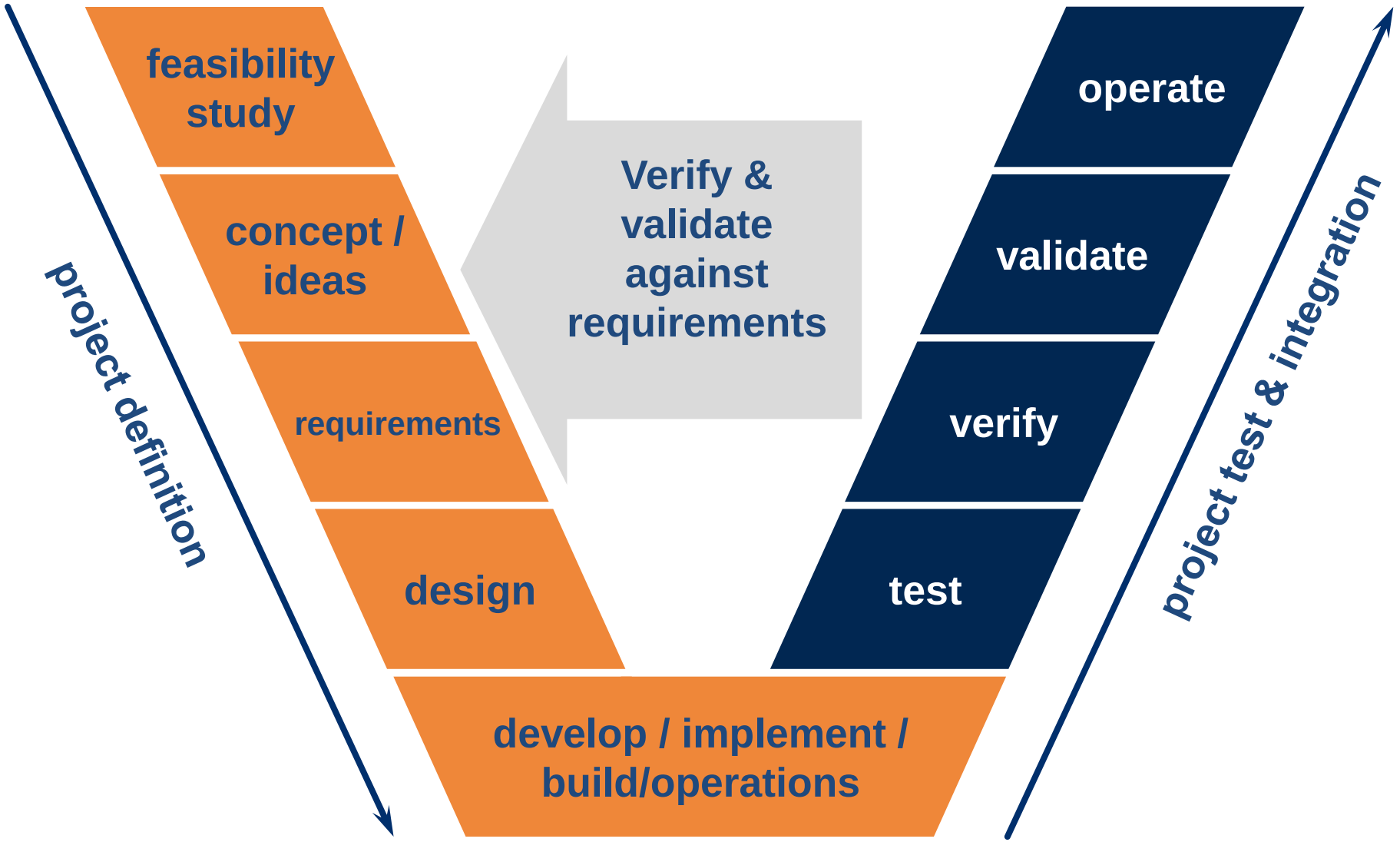
Smarter Testing is the use of physical testing **combined** with **novel digital engineering methods** to accelerate and improve identification of physical failures and predictions of product performance

Digital engineering describes the development of **digital** or **virtual models** to recreate and study **complex physical systems** that may not be suitable for physical testing

Using digital models, a vast quantity of **data** can be gathered in a **short period of time** that might only be achieved otherwise through destructive testing or lengthy physical testing programs

Combining physical and virtual testing in a **Smarter Testing framework** enables a deeper, more detailed understanding of physical systems in an ultimately **more cost and material efficient** manner

Combination of Testing and Digital Engineering:
Full Product Development Life Cycle



Digital Twins

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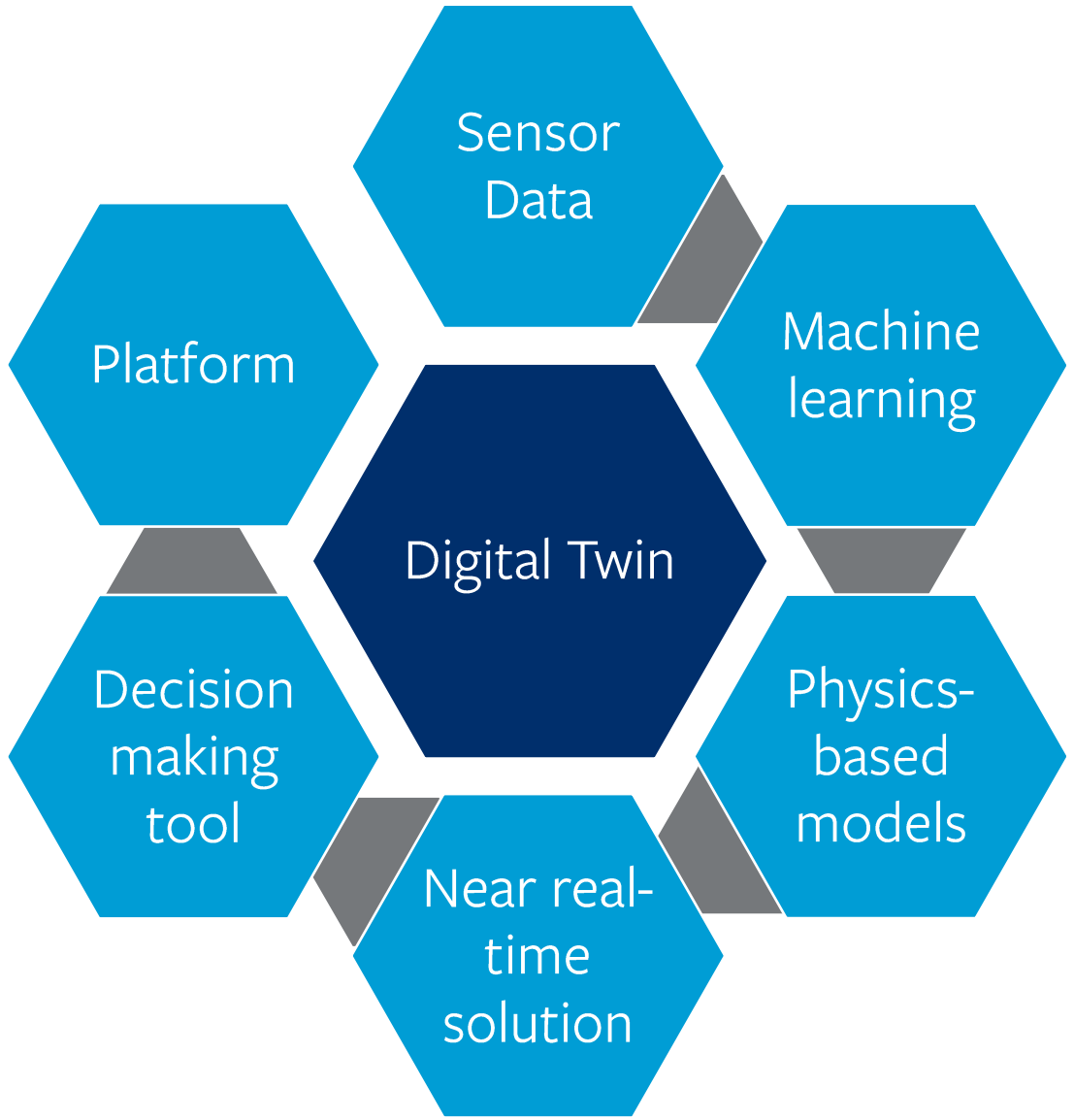
What is a Digital Twin?

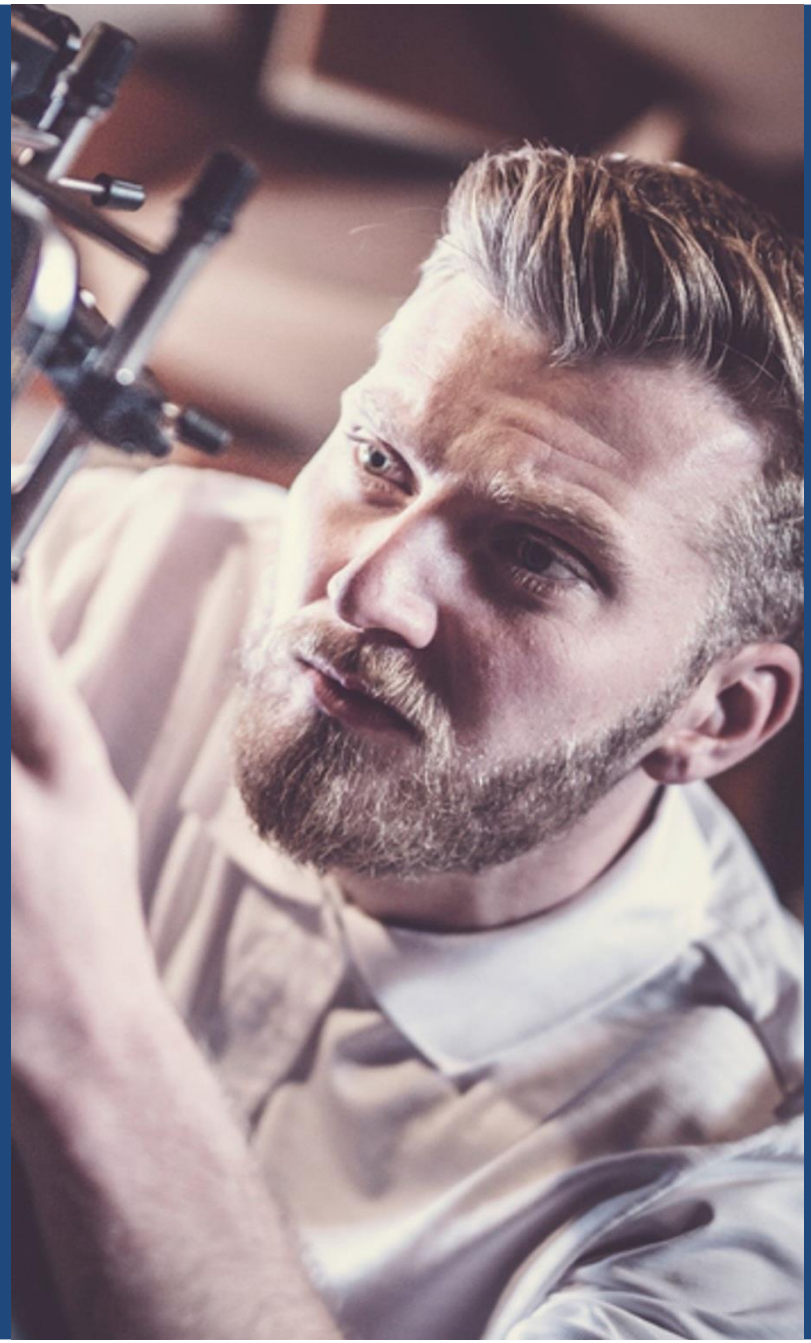
- A virtual representation or recreation of a physical system that utilises real-world data to monitor and predict product performance
- Through data analytics and simulation, we can develop simplified empirical models to model complex systems and give predictive analytic input capabilities for commercial whole life cost modelling
- Real-world data is fed into high speed, real time, computationally lightweight numerical simulations of operating assets to extend the range of immediately available information

Digital Asset Management

- Digital twin technology allows for real-time condition assessment, ultimately leading to better asset management.
- For OEMs and operators, utilisation of digital twins for asset management facilitates:
  - Asset life extension
  - Optimised operation
  - Reduced unplanned downtime
  - Reduced reactive maintenance



Structural Analysis



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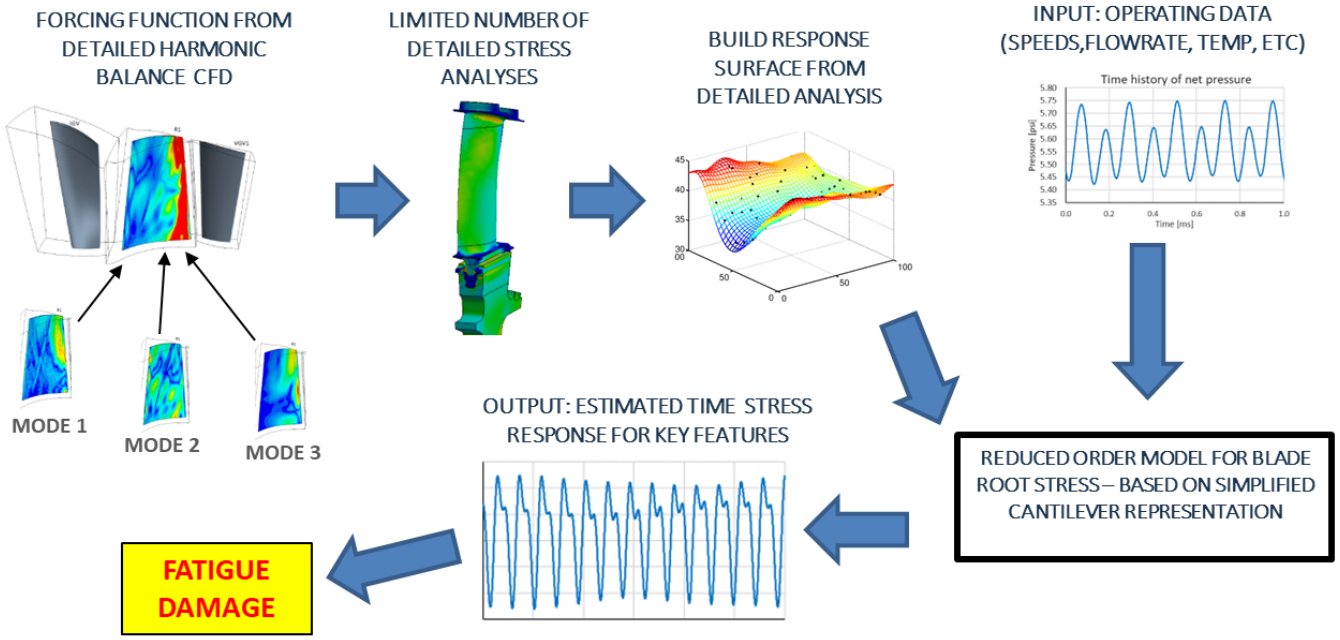
Reduced Order Model Development

Compressor Blade Vibration and Fatigue

An industrial turbine manufacturer required a predictive tool to understand how variation to the operating conditions affected fatigue life.

The current approach required time consuming simulation for each new operating condition, which was impractical to assess due to a wide ranges of potential operating cycles.



High-fidelity CFD and FEA simulations were used to calibrate Reduced Order Models, capable of producing extensive fatigue-lifing results.

This enabled our client to predict fatigue life across a range of operating conditions at a significantly faster rate than using purely physical methods or high-fidelity computational simulation.

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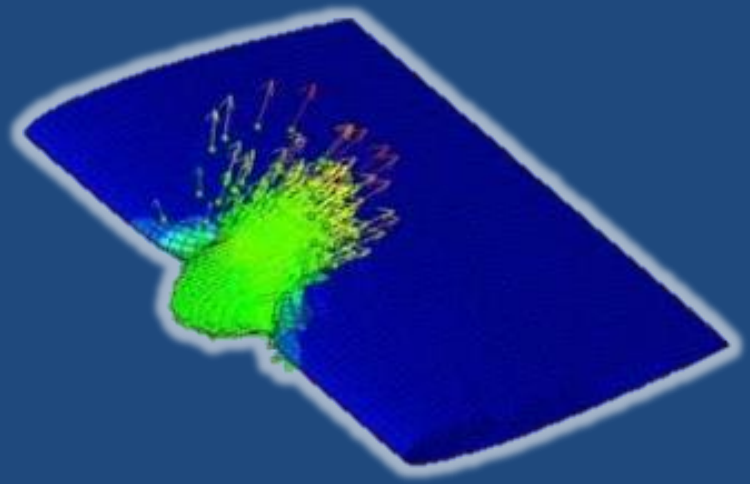
Wing Vulnerability

The vulnerability of a new composite wing needed to be assessed for certification prior to manufacture.

We developed analytical methods to assess impact scenarios such as bird strike, tyre impact and tyre slap, validated against full scale tests, to extend the breadth of available data without incurring the extensive costs and timescales of further destructive physical testing.

The ability to rapidly and systematically vary test parameters has allowed our customer to deploy accelerated support to in-service modifications.



Computational Fluid Dynamics

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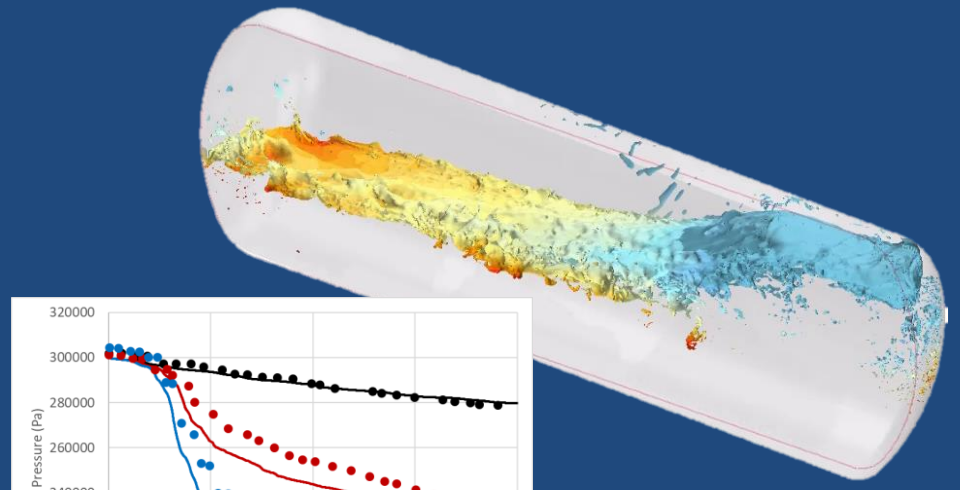
Sloshing of Cryogenic Hydrogen Tanks

AEROSPACE TECHNOLOGY INSTITUTE

Cryogenic liquid hydrogen storage in aerospace applications carries the risk of over-pressurization due to sloshing-induced boil-off.

We implemented a calibrated boiling model into the commercial CFD tool StarCCM+, validated against experimental data, to develop detailed understanding with a considerable reduction in both risk and cost.

We delivered significant, otherwise unavailable insight into the behavior of liquid hydrogen sloshing to a UK government-funded Aerospace program.



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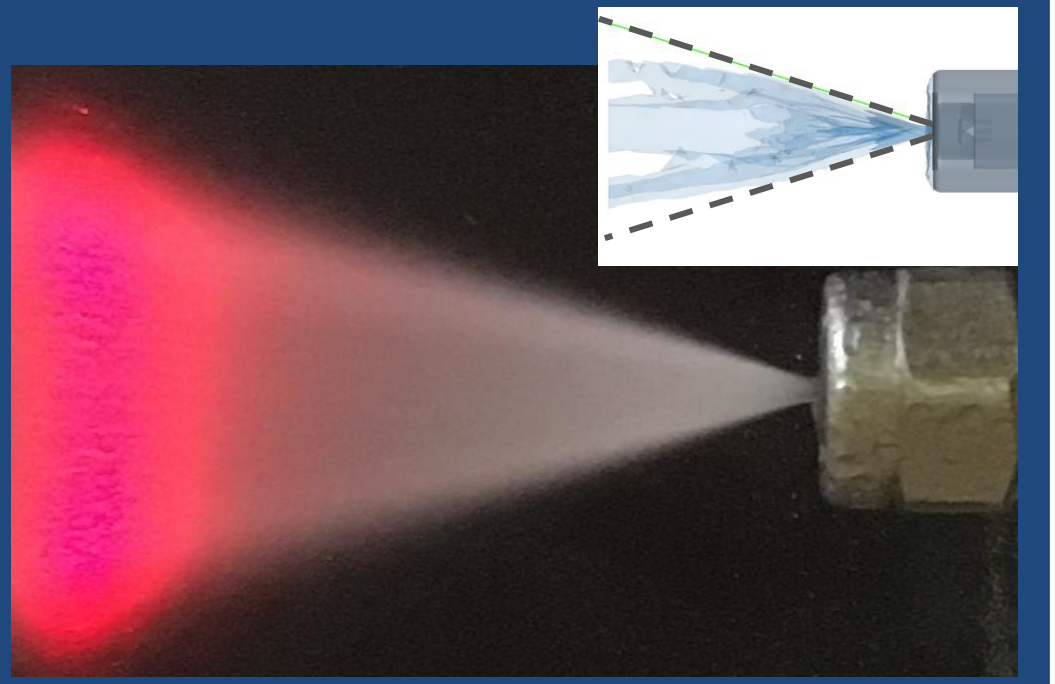
Spray Nozzle Optimisation

An aerospace OEM approached us to support the development of an emission control device through design, optimization, and testing of a spray nozzle.

Using high-fidelity CFD modelling informed by real-world test data, we assessed the impact of geometric parameters on spray characteristics, allowing for the identification of an optimised nozzle design.

By deploying advanced optimisation algorithms, we greatly reduced the time taken to achieve our optimised design that ultimately delivered a 60% increase in performance compared to original nozzle.



THANK YOU

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