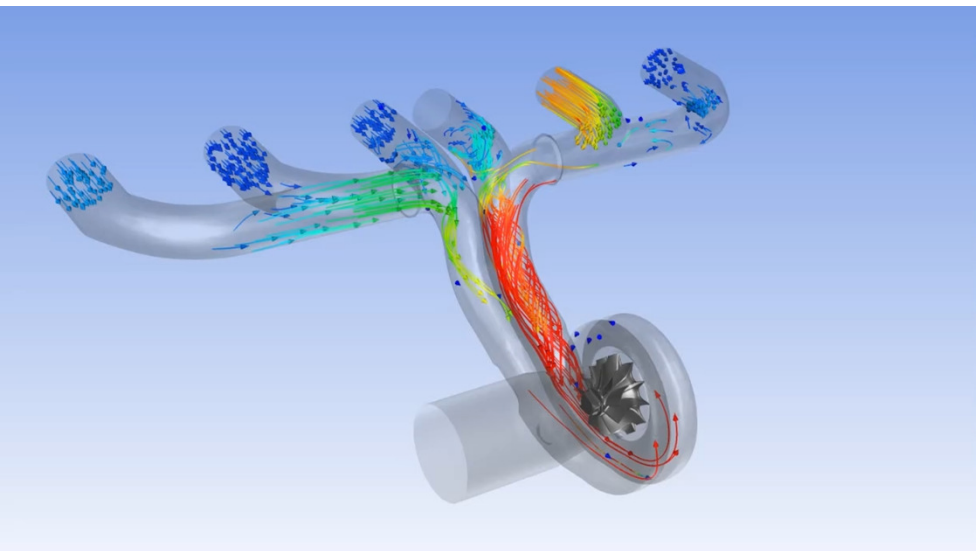


um
2025

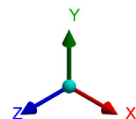
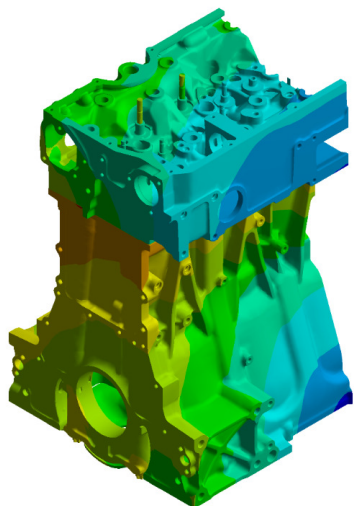
Simulation Based Product Development at Cummins Inc. and the Evolution of Optimization, Automation and Robustness

Bob Tickel
Director, Multidisciplinary Simulation





Agenda



5 MINUTES

This is the Power of Cummins

Brief overview of Cummins Inc. and personal introduction

10 MINUTES

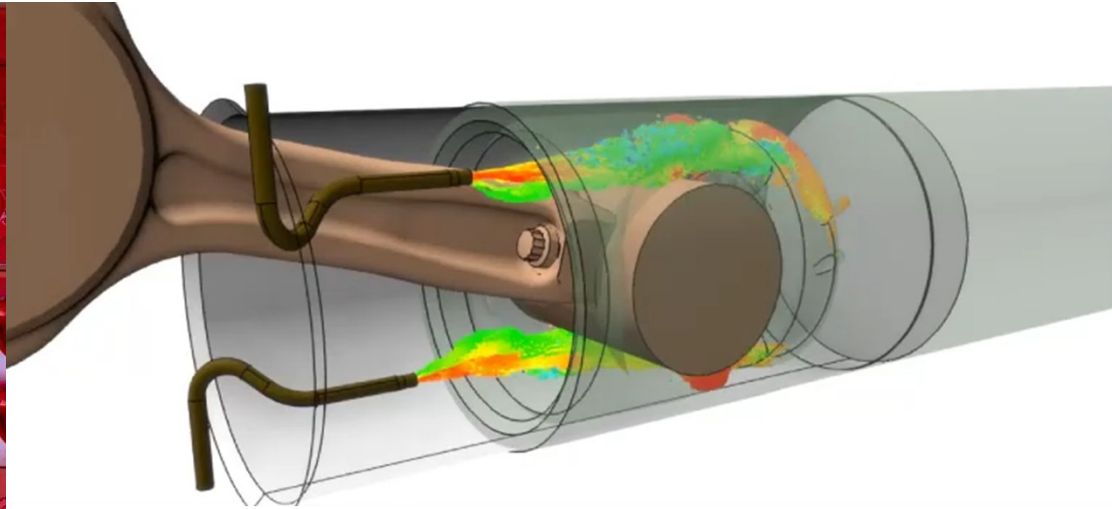
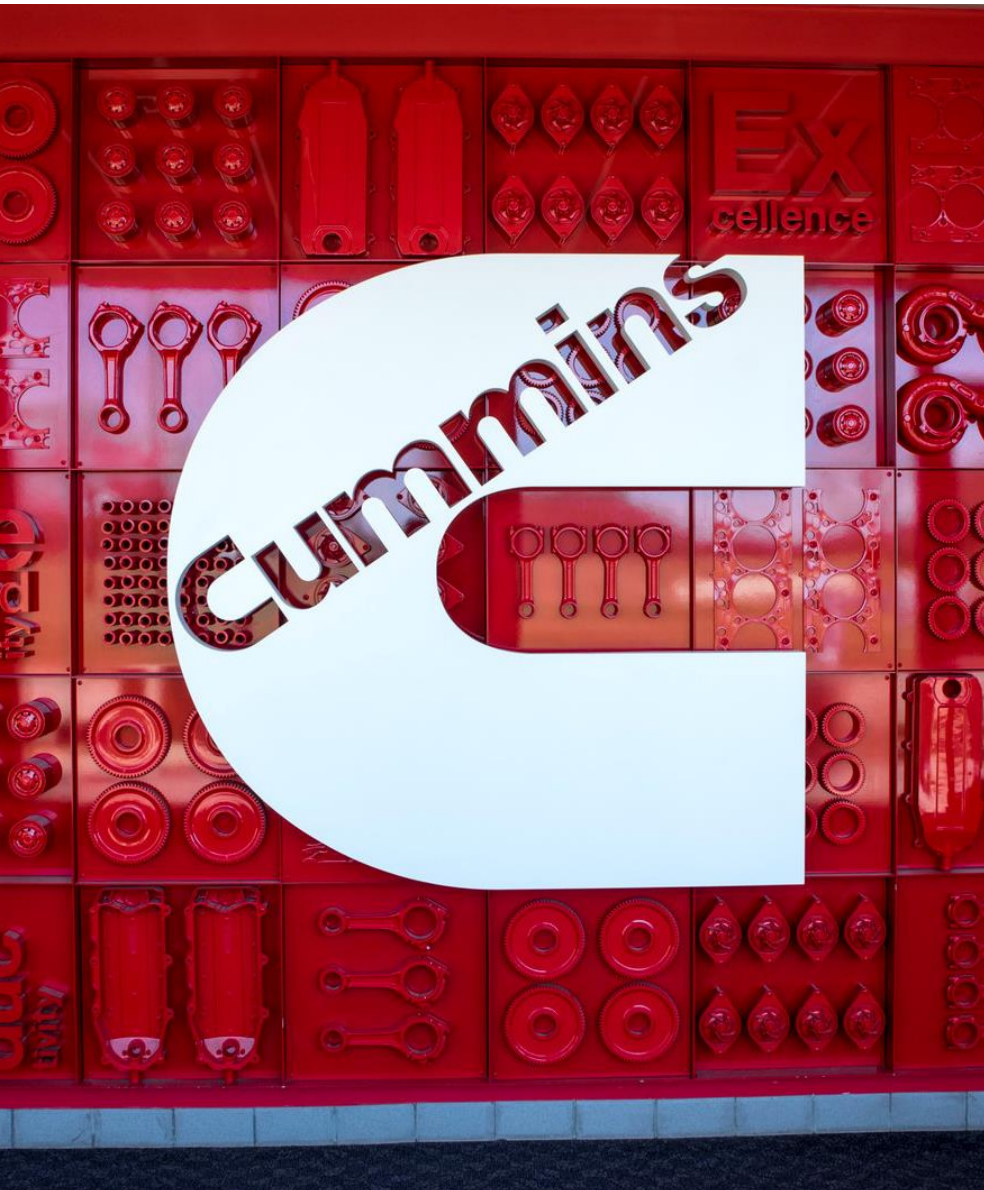
SBPD

Overview of and history behind Simulation Based Product Development (SBPD) and evolution of Optimization, Automation and Robustness (O.A.R.)

5 MINUTES

Democratization

The path to simulation driven decision making across the enterprise.



THIS IS THE

Power of Cummins and Personal Intro

Our history

For more than 100 years, we have defined ourselves by our unwavering values and our promise of innovation and dependability. In the next 100, we will continue to challenge the impossible. Here's a look at some highlights from our past 106 years:

1919
Clessie Cummins creates the Cummins Engine Company based in Columbus, Indiana (U.S.A). William G. Irwin, who employed Cummins as a driver, supplies nearly all the \$50,000 in startup capital.



1929
Cummins takes Irwin for a ride in a used Packard limousine that he equipped with a diesel engine on Christmas day, convincing Irwin of the engine's potential. Irwin invests a much-needed infusion of cash.

1932
Cummins barnstorms across the country, demonstrating the power and fuel efficiency of the diesel engine on his coast-to-coast Cummins diesel test bus.



1937
Cummins earns its first profit.

1944
Miller becomes Executive Vice President of Cummins.

1951
Miller becomes Chairman of the Cummins Board



1962
Cummins begins operations in India, first as a joint venture with one plant in Pune.

1975
Cummins enters China as part of a deal involving heavy construction equipment with Cummins engines

1986
Cummins purchases 86 percent of the Onan Corporation in Minneapolis, Minnesota (U.S.A), which would become the basis for its Power Generation Business.

2000
Cummins Engine Company becomes Cummins Inc. to acknowledge it is also a leader in global markets including filtration and power generation.

2017
Cummins redefines our story including the mission and values around its vision of "Making people's lives better by powering a more prosperous world"

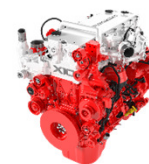
2019
Cummins celebrates its 100-year anniversary

2022
Cummins launches Destination Zero, its strategy to go further, faster to reduce the greenhouse gas and air quality impacts of its products while growing its business.

*Cummins unveils industry-first fuel-agnostic internal combustion solutions, helping fleets decarbonize with low-carbon fuels.

2023
Cummins launches Accelera™ by Cummins, a new brand for its business segment providing a diverse range of zero-emissions power solutions.

2024
Cummins reintroduced its fuel-agnostic platforms as HELM™ (Higher Efficiency. Lower Emissions. Multiple Fuels).



**Powering
a more prosperous
world**

190 Countries and territories*

69,600 Global employees

106 Years of industry leadership

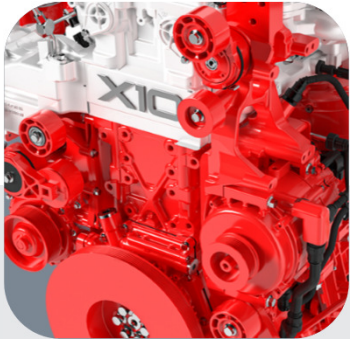
19,000 Cummins certified dealer locations

\$1.4B Invested in research and development in
2024

* Approximation of countries and territories with Cummins service. As published in the 2024 10K found on [cummins.com](https://www.cummins.com).

Five operating segments

Cummins has a long track record of delivering leading power solutions. As we look ahead, we know our industries and regions will continue to change, and we are committed to bringing our customers the right technology at the right time.



Engine



Power Systems



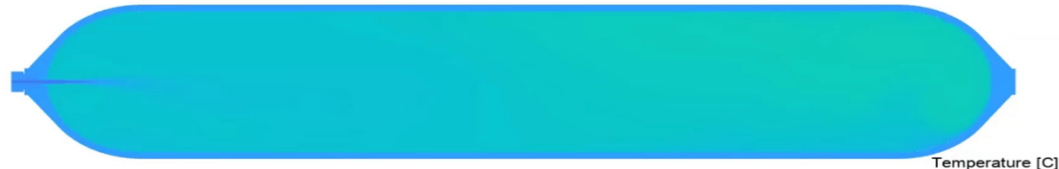
Components



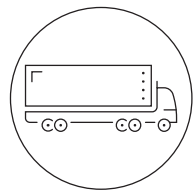
Distribution



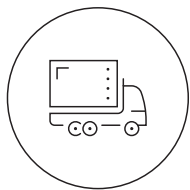
**Accelera™ by
Cummins**



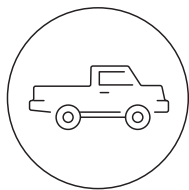
Applications



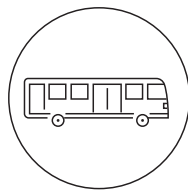
Heavy-duty truck



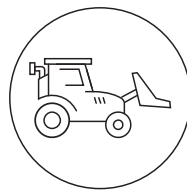
Medium-duty truck



Pickup truck



Bus



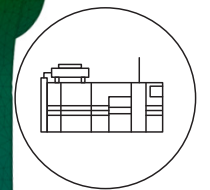
Construction



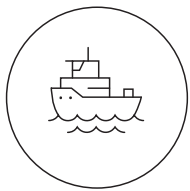
Oil & Gas



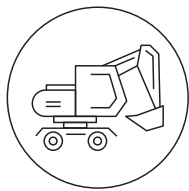
Fire & Emergency



Electrolysis



Marine



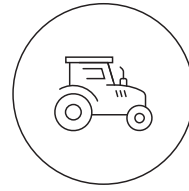
Mining



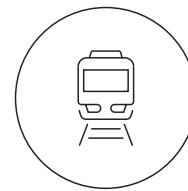
Recreational Vehicle



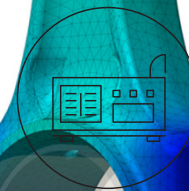
Defense



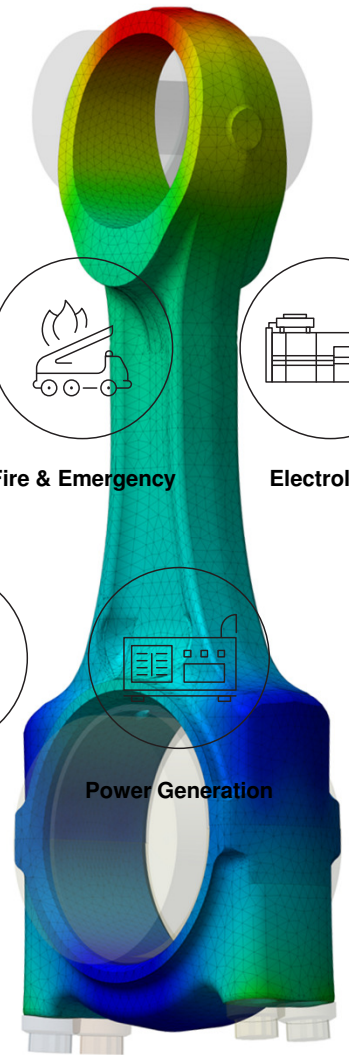
Agriculture



Rail



Power Generation

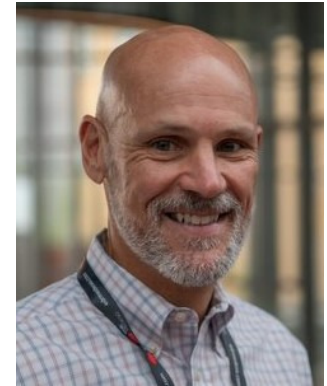
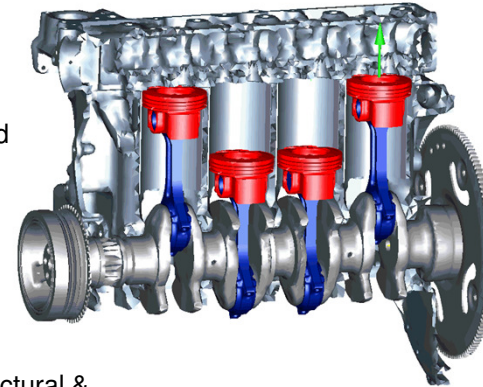


This is not an exhaustive display of Cummins-powered markets. Please refer to cummins.com for the most updated product information.

Bob Tickel

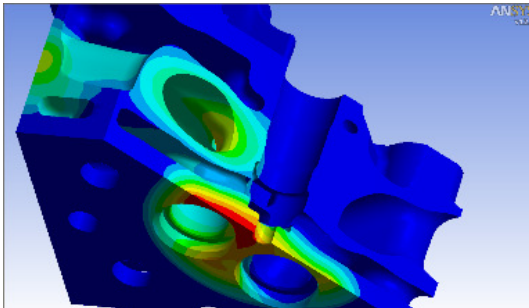
2020 – ????: Director
Multi-Disciplinary Simulation, Advanced
Engineering – Corporate R&T

2007 – 2019: Director
Structural & Dynamic Analysis & World-Wide
Applied Mechanics FE Lead



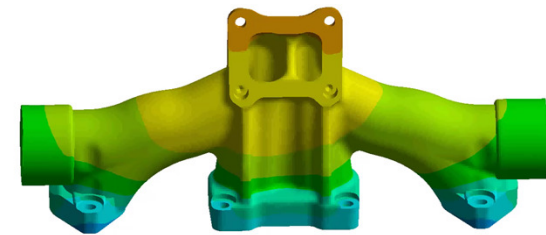
**2001 – 2007: Manager – Structural &
Dynamic Analysis**

**1997 - 2001: Technical
Advisor – Structural &
Dynamic Analysis**



1995 - 1997: Technical Specialist
– Heat & Fluids – R&T

**1993– 1995: Senior Engineer –
High Horsepower Engineering –
Premier 19**



1988

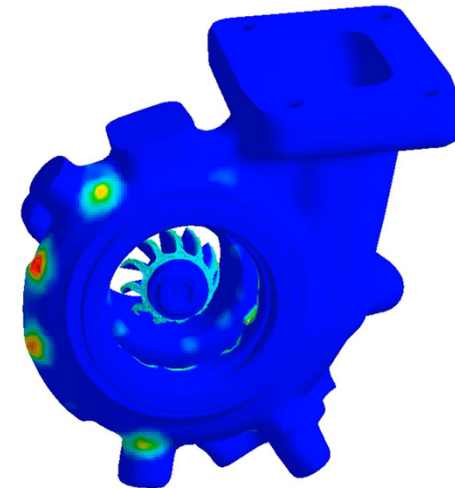
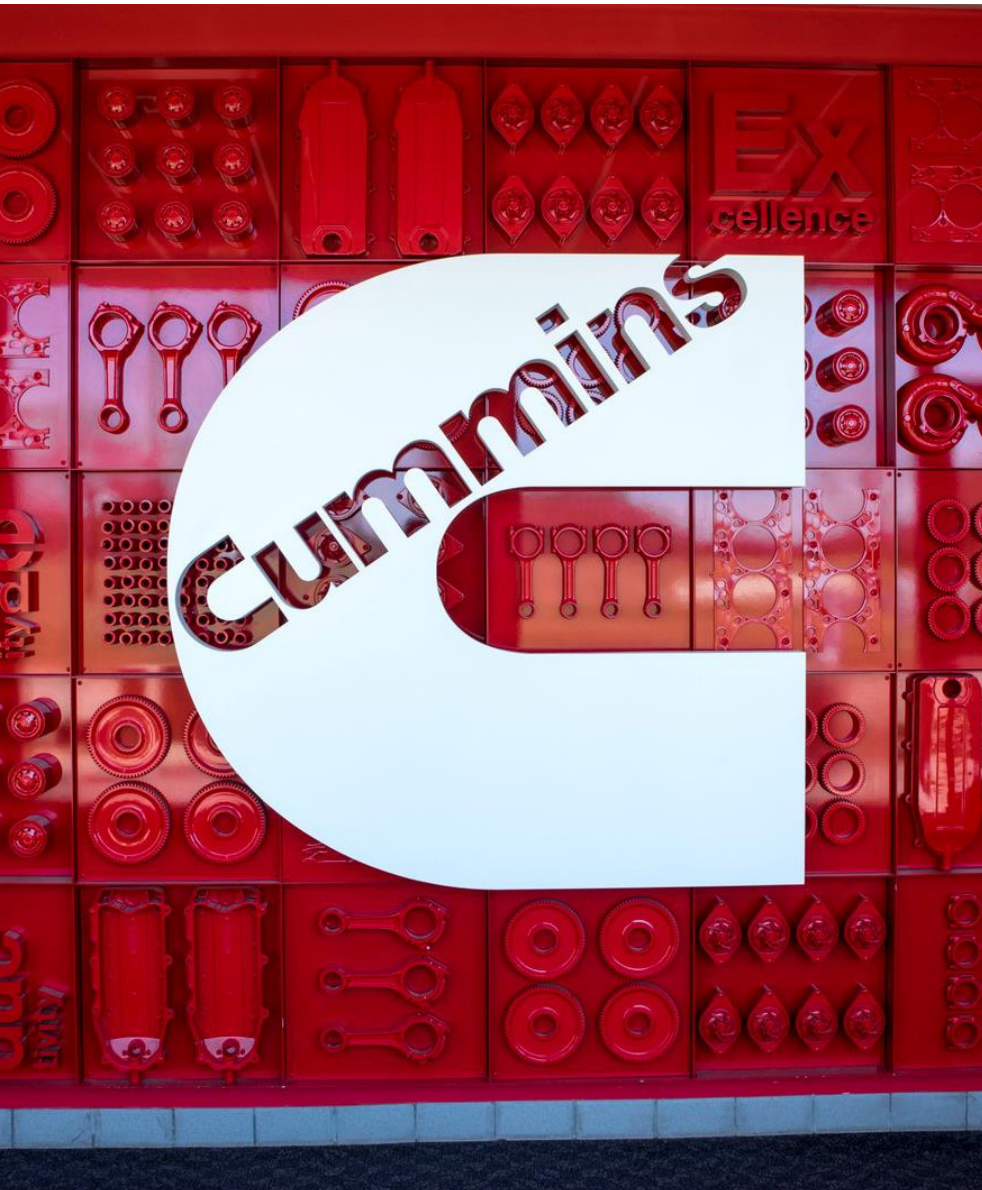


1988 – 1992: Development Engineer V 903

Education



1988 1994

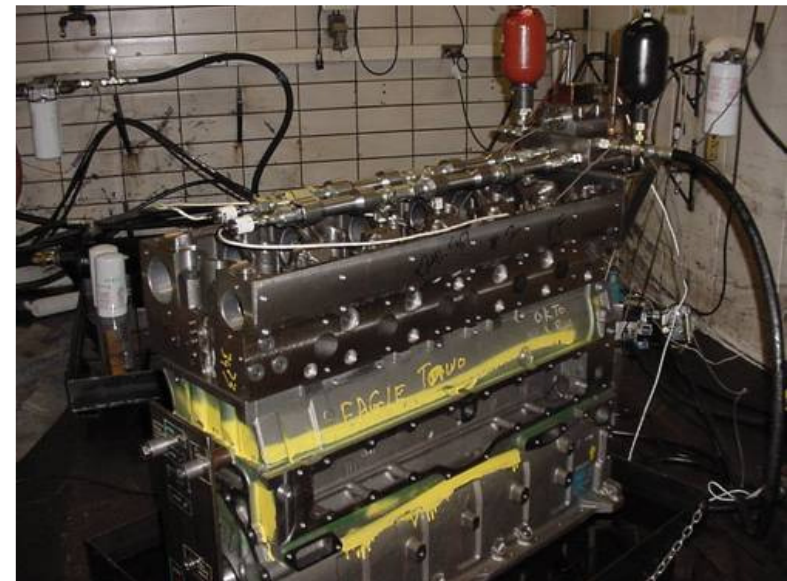
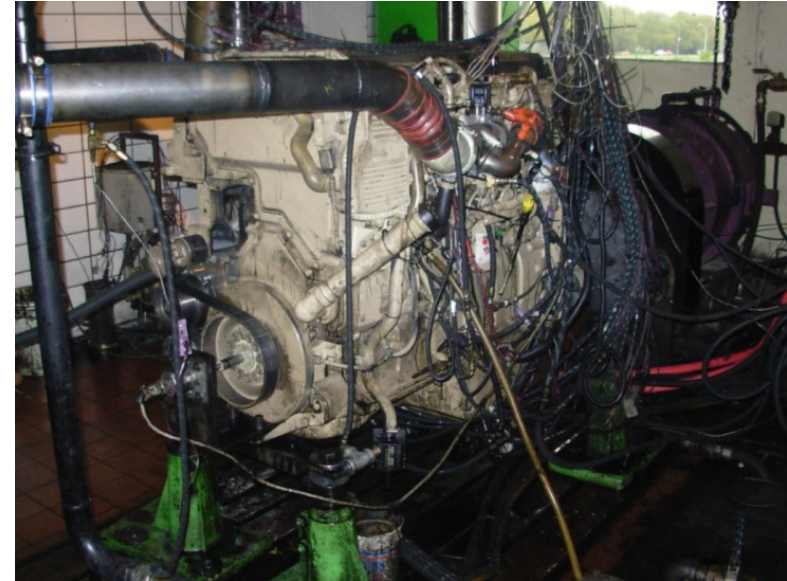


Simulation Based Product Development (SBPD)

Overview of and history
behind SBPD

The Past - 1919-2000's

- A successful history of build it – test it
- Simulation component focused and/or discipline-centric
- Performance and Emissions key drivers
- Several factors energized a top-down initiative called “Analysis Led Design” (ALD) focused on Technical Productivity based on accelerating the use of modeling and simulation
 - Economic downturn (2001-2002)
 - Expanding global products
 - Expanding complexity of products
 - Need for reduced introduction times/cost
 - Need for more robust products
 - Achievements in the combustion arena



The Past – 2000's


ALD, Top-down ***initiative*** to accelerate the use of analysis

- Don't run tests unless analysis results are available, Reduce/minimize testing based on analysis
- Make resources available - 500 people in Pune, India doing design, cfd and structural analysis – started in 2002
- Train and equip project leaders, Measure progress - accountability
- Best products, delivered on time at the lowest cost



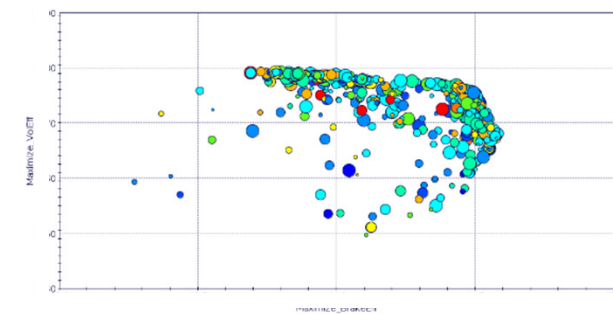
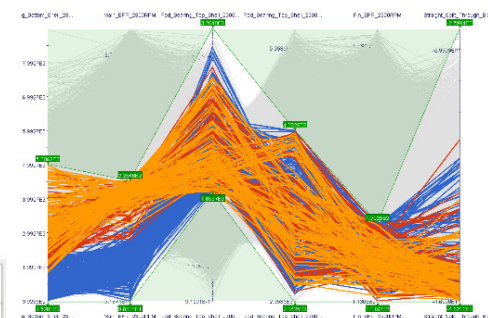
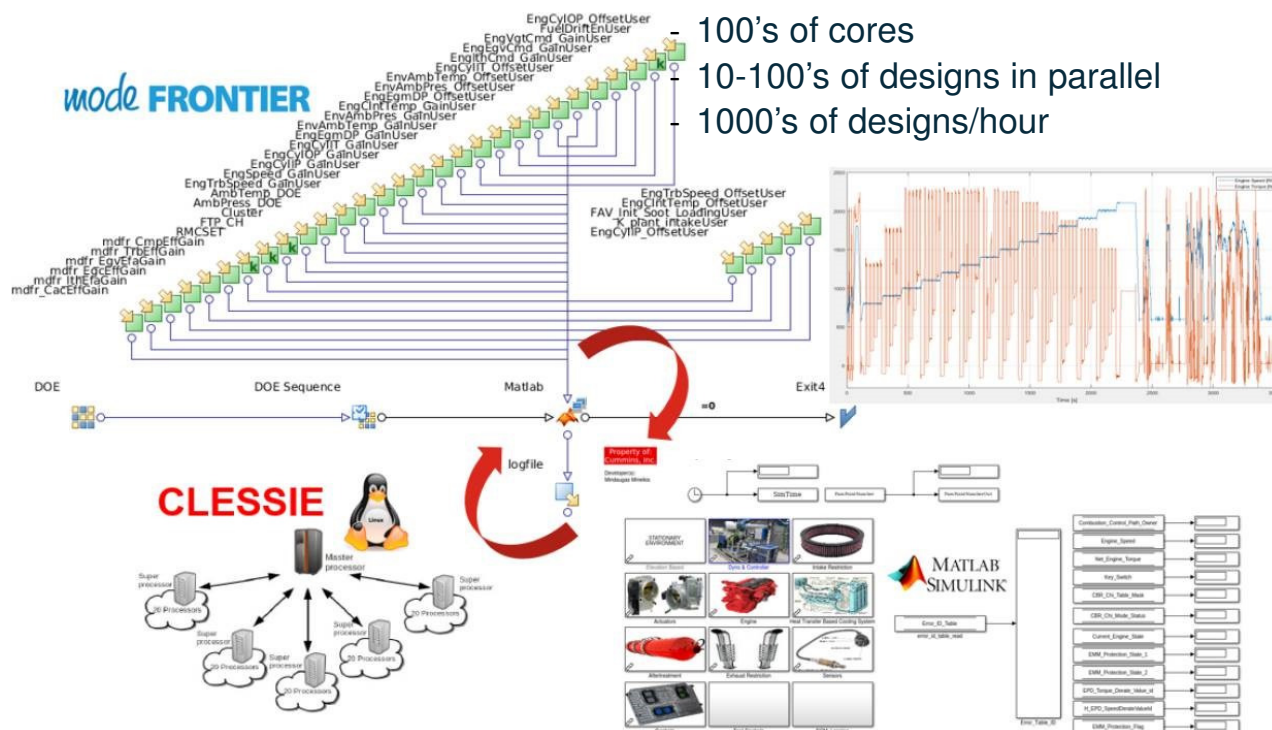
	\$\$	Time
Analysis	1k	Days
Component Rig Test	10k	Weeks
System Test	100k	Months

The Past – 2000's – 2020

- Multi-Disciplinary Optimization
 - Automation
 - Optimization
 - Visualization
 - Non-denial license agreements
 - High performance computing
- “Full” design space exploration
- 

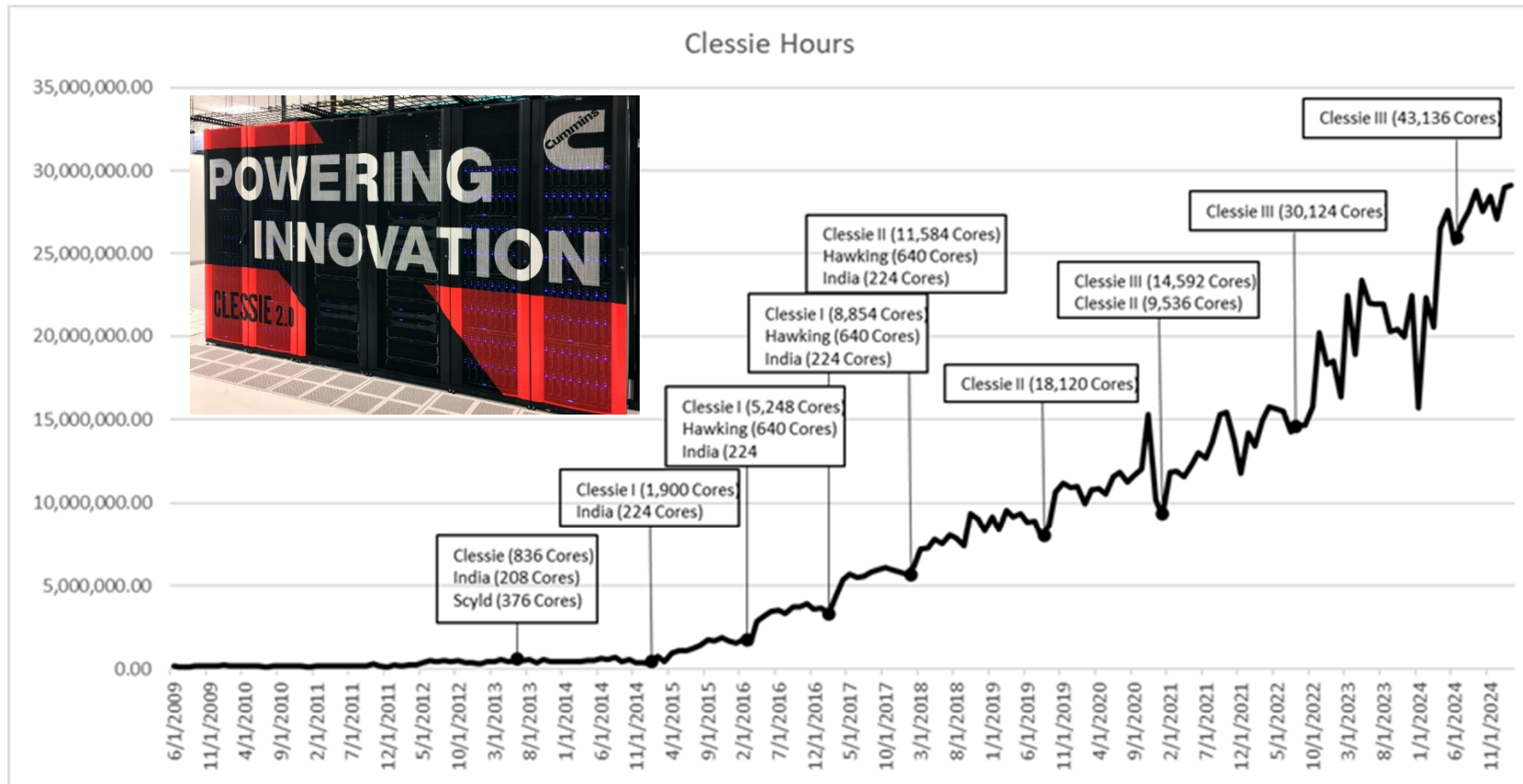
“Full” design space exploration

- 10's of thousands of simulations
- 100's of cores
- 10-100's of designs in parallel
- 1000's of designs/hour



The Past – 2000's – 2020

High Performance Computing for Product Development



The Present – 2020's

- Internal and external assessments indicated opportunities for improvements
- Top-down initiative created called Simulation Based Product Development

Simulation Based Product Development (SBPD) focuses on thoughtfully integrating simulation with complementary testing to deliver products and solutions that are right the first time and robust for all our customers' uses.

People

Ex. Talent Review & Skills Dev.

Process

Ex. Engineering Std Work & Metrics

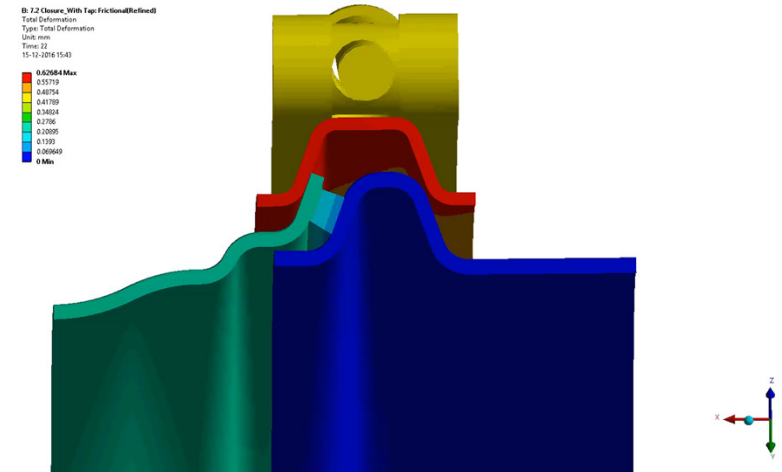
Tools

*Ex. Common Sim Software &
Simulation Process/Data Mgmt*

- We validate products via tightly integrated Sim & Test approaches that have a physics-based linkage to field usage
- We use tools with the right amount of input fidelity & simulation complexity to match the architecture or design decision being made
- We use simulation to select architectures and designs that are inherently robust in meeting key requirements.
- We increase adoption of simulation use thru model availability, reusability, and workflow automation
- We develop leaders who consistently drive use of both Sim and Test on tough decisions & problems
- We develop simulations that are useful for estimating remaining life or for prognostics

SBPD ~> O.A.R.





Democratization

Opportunities

Types of models and simulation

- Components
- Systems
- Manufacturing processes
- Performance
- Cost
- Emissions
- 0-D, 1-D, 3-D
- Fast and/or Accurate – concept through validation
- Throughout Lifecycle - Design-Service-Re-manufacturing

Have many vendor partnerships...Esteco is one of those key vendors.

- modeFRONTIER
- Volta
 - BPM
 - Cardanit
 - ...

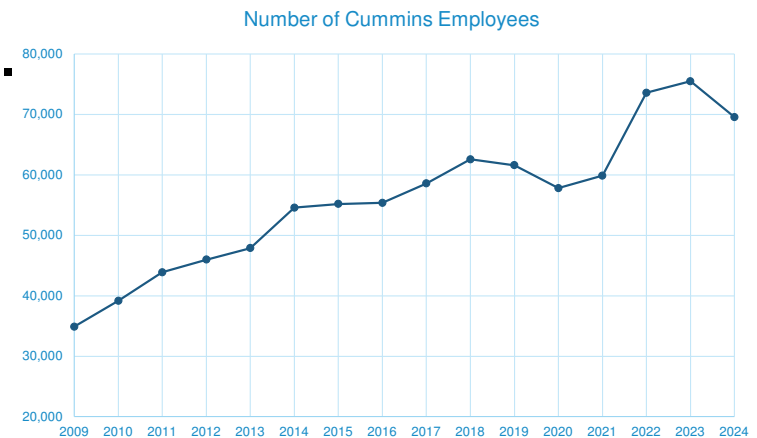
Democratization

Democratization is the drive towards simulation-based decision making across the enterprise.

Methods –

- Documentation
- Training
- Automation
- Reduced order models / Machine learning
- Simplified tools

How can we best use tools from Esteco to leverage our human capital with reduced order models, automation, etc?



Q+A



um
2025

ESTECO
USERS' MEETING
NORTH AMERICA

Thank you!

esteco.com



[Read the ESTECO Copyright Policy](#) © 2025 ESTECO SpA