

Innovative Synergies: Accelerating Development with Simulation and AI

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Today's Agenda

- Introduction to CAD-IT Consultants
- Conventional Simulation Technique
- Simulation-Based Optimization
- Simulation-based Digital Twin
 - Reduced Order Models (ROM)
 - Hybrid Digital Twins: Combining Data and Physics
- The integration of AI & ML into traditional engineering simulations
- Conclusion

Introduction to CAD-IT Consultants

The background of the slide features a stylized world map in the upper left and a large, faint footprint icon in the center. The footprint is composed of two footprints, one slightly larger than the other, with small dots representing toes. The entire slide has a dark blue background with a subtle network pattern of dots and lines.

CAD-IT's Global print

Founded in 1991, CAD-IT is a global company with 23 companies, 19 offices, and 3 factories in 15 countries spanning 4 continents, with 160 international & national awards and over 600 staff.



CERTIFIED ELITE CHANNEL PARTNER

Partnership with Ansys

As an Elite partner of ANSYS, Inc., the world's leading engineering simulation developer, in the ASEAN and China regions, CAD-IT has a proven track record of success and is extremely honored to have received numerous ANSYS Outstanding Performance Awards since 1995, in recognition of her excellence in sales, marketing, provision of training, services and technical support of the entire range of ANSYS solutions.

Conventional Simulation Technique

A Vision for the Future of Simulation



Millions of times a day, people around the world make better decisions faster based on insights rooted in our ubiquitous simulation — the cloud-powered platform running in the background of millions of products, services, and devices everywhere.

Hundreds of thousands of times a day, engineers, analysts, or technical specialists everywhere use our extended capabilities as part of a model-based workflow, using our integrated and **intelligent simulation platform**, informed by **AI/ML**.

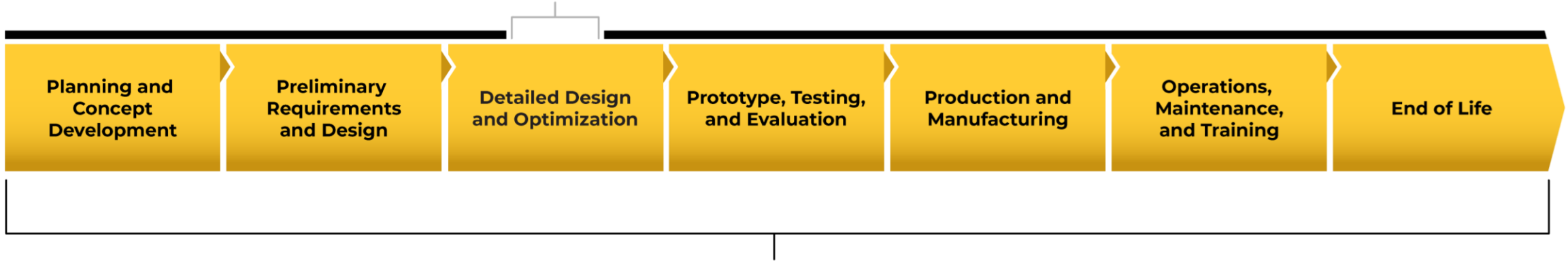
Thousands of times a day, expert engineers and scientists use engineering simulation technology to develop and validate the design of products and systems.



Simulation is Essential for Digital Transformation



Simulation tools historically limited to design optimization used by specialists.



Ansys' capabilities extend simulation value across the entire product life cycle



9X ↓
REDUCTION IN
DEVELOPMENT TIME

1,000X ↓
REDUCTION IN VALIDATION
TIME FOR COMPLEX SYSTEMS

25% ↓
WEIGHT REDUCTION
WITH TOPOLOGY OPTIMIZATION
ADDITIVE MANUFACTURING

10-20% ↓
REDUCTION IN O&M COSTS

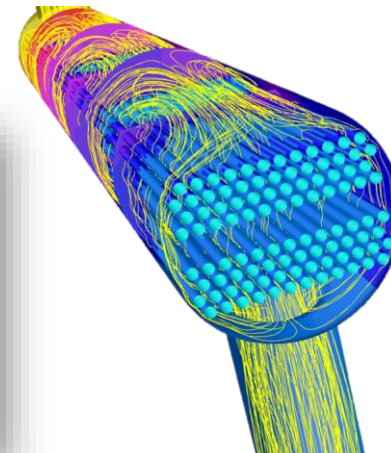
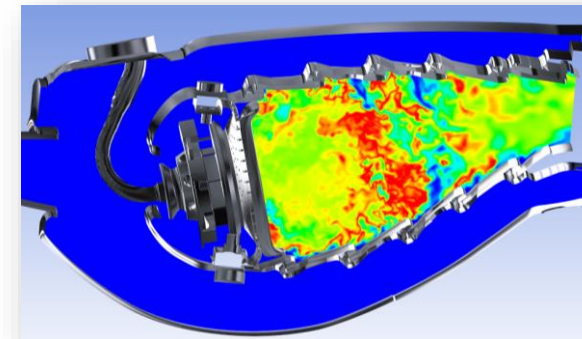
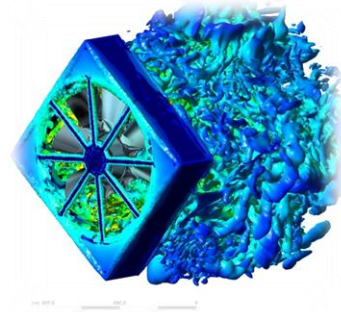
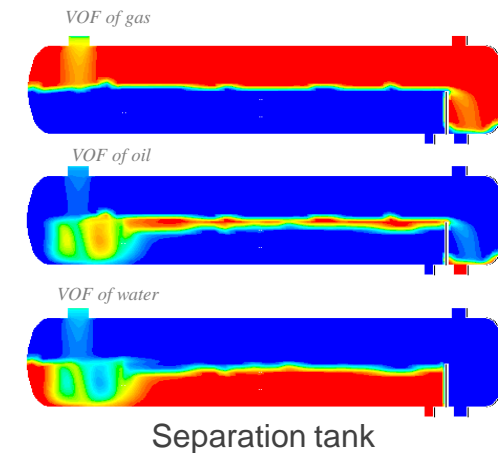
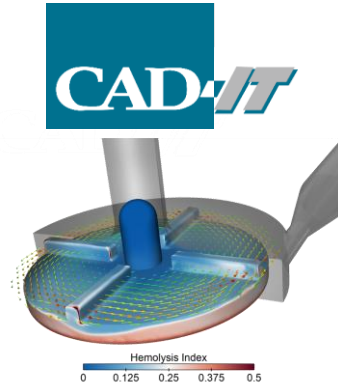
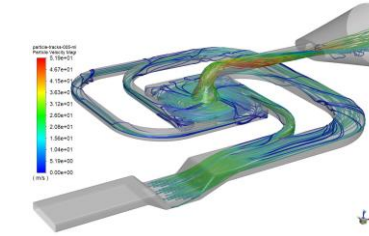
Reduction numbers based on industry-specific customer testimonials

CFD in Ansys

Ansys CFD is the most powerful general-purpose computational fluid dynamics (CFD) tool. Well-validated physical modeling capabilities deliver fast, accurate results across the widest range of CFD and multiphysics applications

Ansys CFD Key Benefits

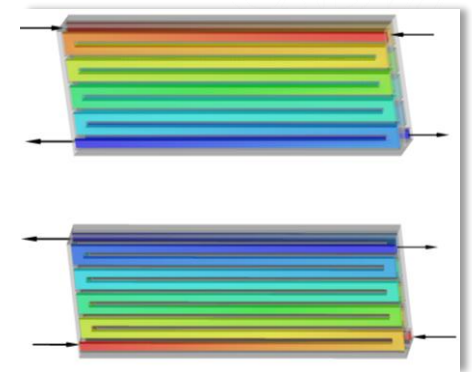
- ✓ Prevent excessively high temperature regions to ensure product quality and safety.
- ✓ Ensure maximum efficiency to optimize energy use.
- ✓ Optimize cooling systems for consistent process temperatures and safety.
- ✓ Predict system thermal behavior for better process control and optimization.
- ✓ Design better combustion systems to improve efficiency and reduce emissions.
- ✓ Develop clean burners/combustors to minimize pollutants and comply with regulations.
- ✓ Avoid costly downturn during retrofit by predicting the impact of modifications.
- ✓ Accelerate time to market by reducing the need for extensive physical testing.



Industry-leading general purpose CFD tool: Ansys Fluent

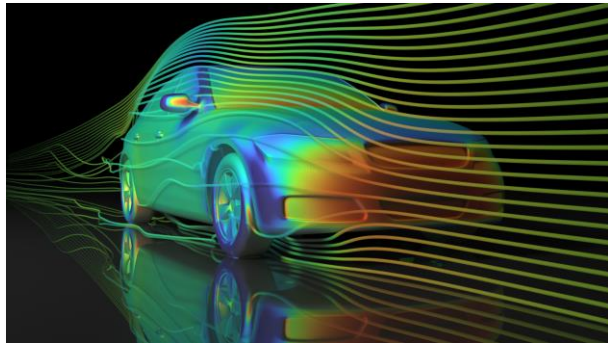
Accurately models the most challenging fluid flow applications

- *Vast range of physics models and applications*
- *Highly customizable*
- *CPU & GPU solvers*



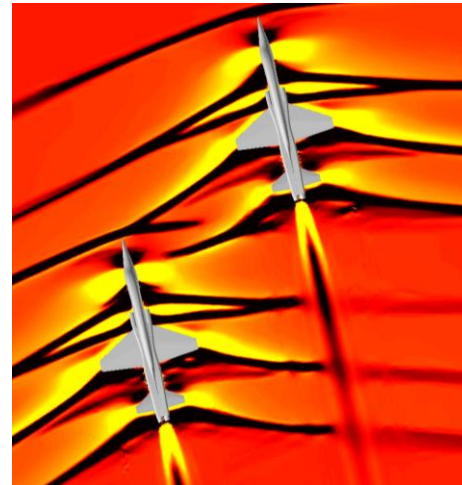
Energy & Industrial Equipment

Hydrogen production (electrolysis), storage, transportation and consumption (fuel cells, combustion); oil & gas; power generation; gas turbines; furnaces; ...



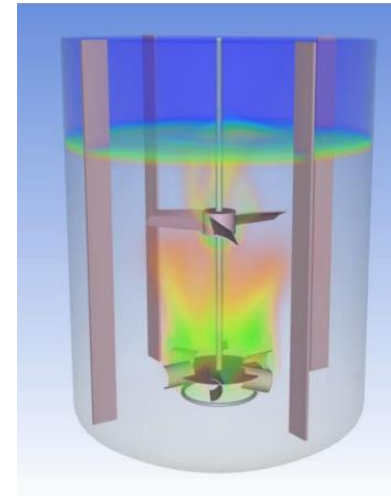
Automotive

Aerodynamics, e-motor, battery, gear box, cabin comfort, cooling, aeroacoustics, ...



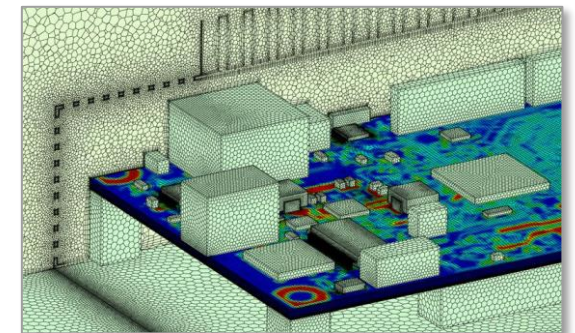
Aerospace & Defense

Low speed, supersonic, hypersonic, aero-optics, propulsion, cooling, aeroelasticity, aeroacoustics, ...



Chemical & Materials

Mixing, transportation, flow control, batch processing, reactions, drying, coatings, packaging, ...



High Tech

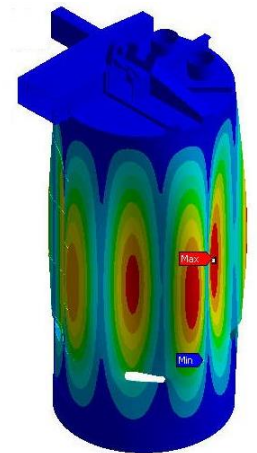
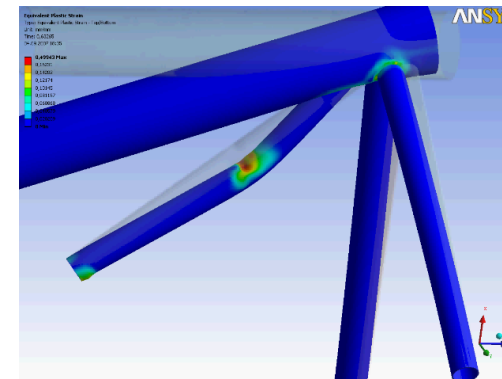
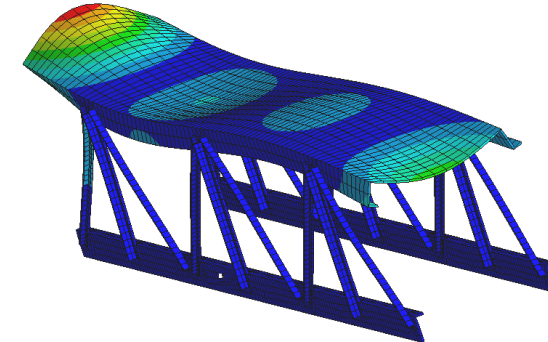
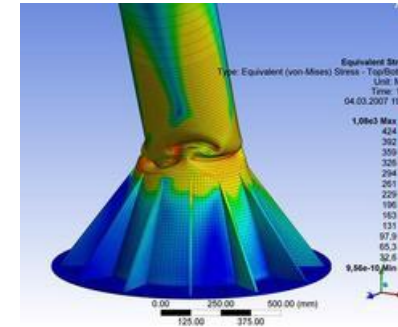
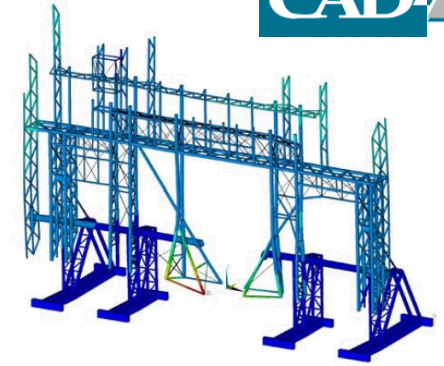
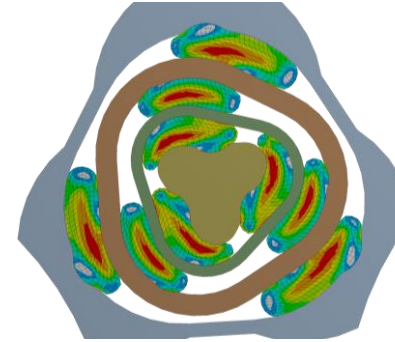
Cooling, condensation, semi manufacturing, ...

Structural Simulation in Ansys

Ansys provides in-depth analysis of structural and coupled-field behaviors for broad structural analysis needs through a suite of finite element analysis (FEA) solutions.

Ansys Mechanical Key Benefits

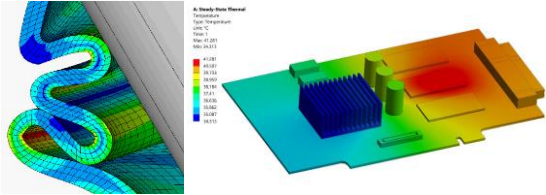
- ✓ Design for performance under given loading conditions
- ✓ Identify load capacity
- ✓ Post-failure analysis and repairs
- ✓ Re-design of components
- ✓ Product durability under real life loading
- ✓ Durability for large or complex models
- ✓ Identify critical natural frequency of the structure
- ✓ Sound analysis
- ✓ Ensure safety in case of sudden and random shocks
- ✓ Accelerate time to market (less trial & error)



Industry-leading general purpose FEA tool: Ansys Mechanical



Strength & Thermal Analysis



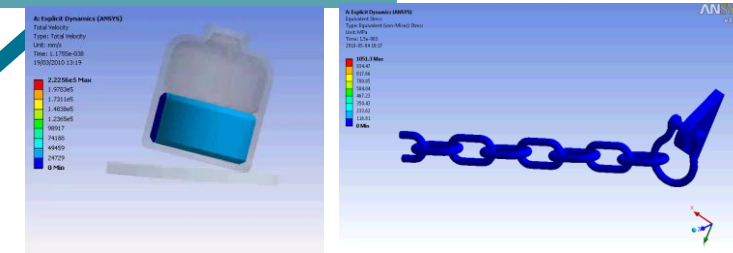
Stresses, deformation and temperature

Structural Optimization



Weight-optimized designs

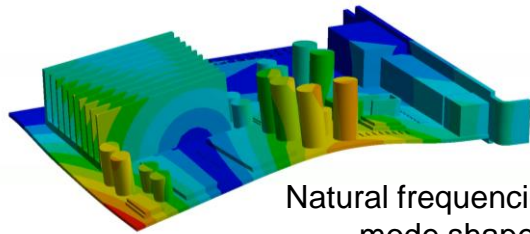
Explicit Dynamics



short-duration severe loading

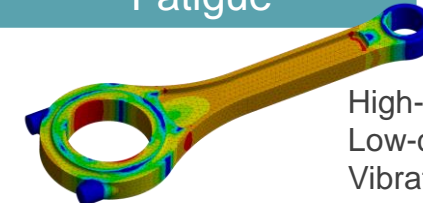
Ansys Mechanical

Modal Analysis



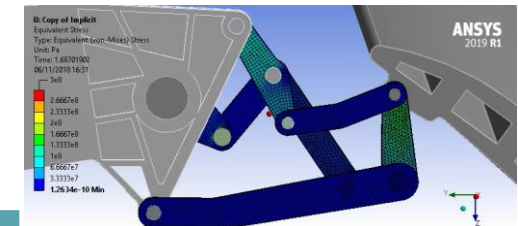
Natural frequencies and mode shapes

Fatigue



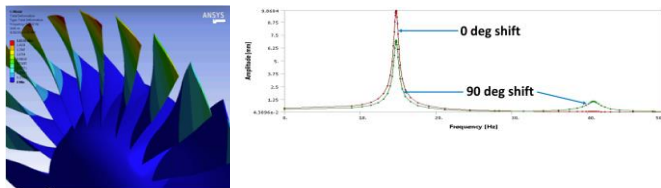
High-cycle fatigue (Stress-Life)
Low-cycle fatigue (Strain-Life)
Vibration Fatigue

Multi-Body Dynamics



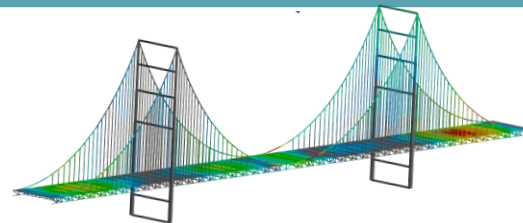
Rigid/Rigid & Rigid/Flex

Harmonic Analysis



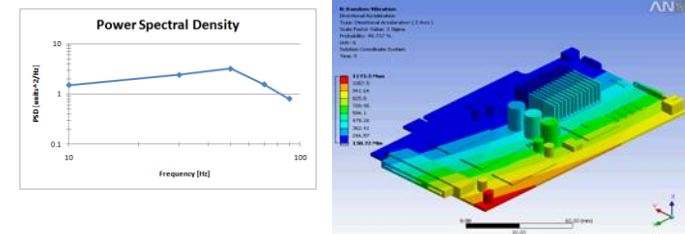
Harmonic loads and FRF

Response Spectrum Analysis



Earthquakes, wind loads, ocean wave loads,
jet engine thrust, rocket motor vibrations

Random Vibration Analysis



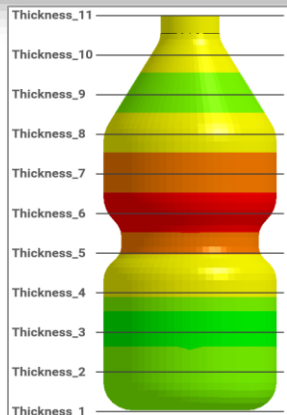
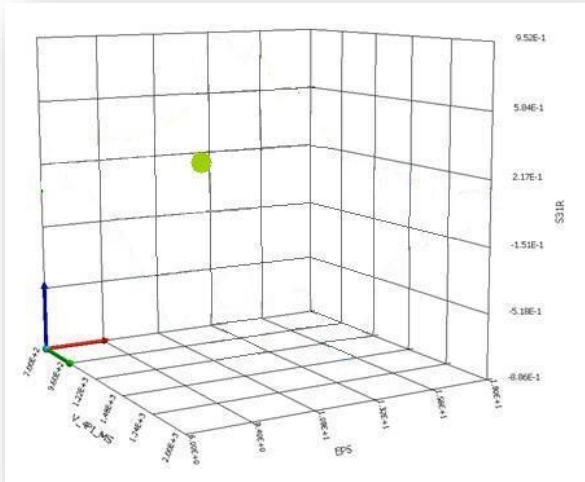
Road load data, Manufacturing line, Launching

General purpose structural analyses

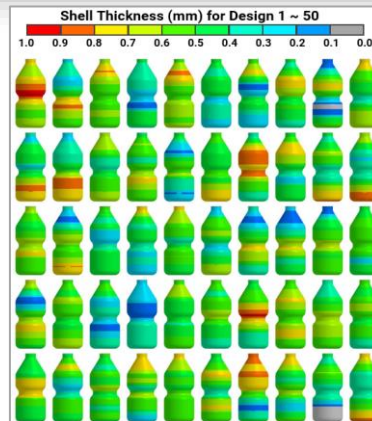
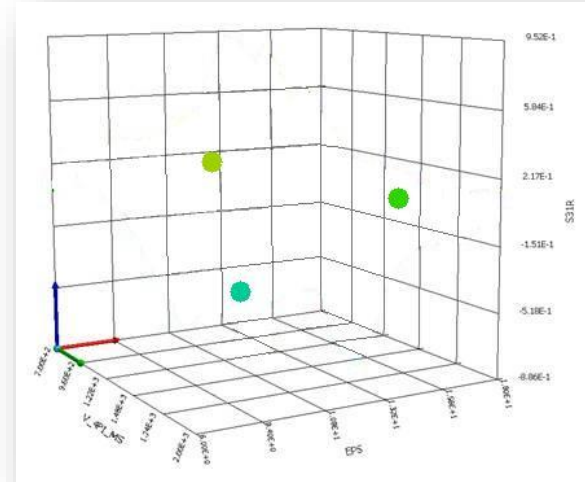
Simulation-Based Optimization

Simulation-based Optimization

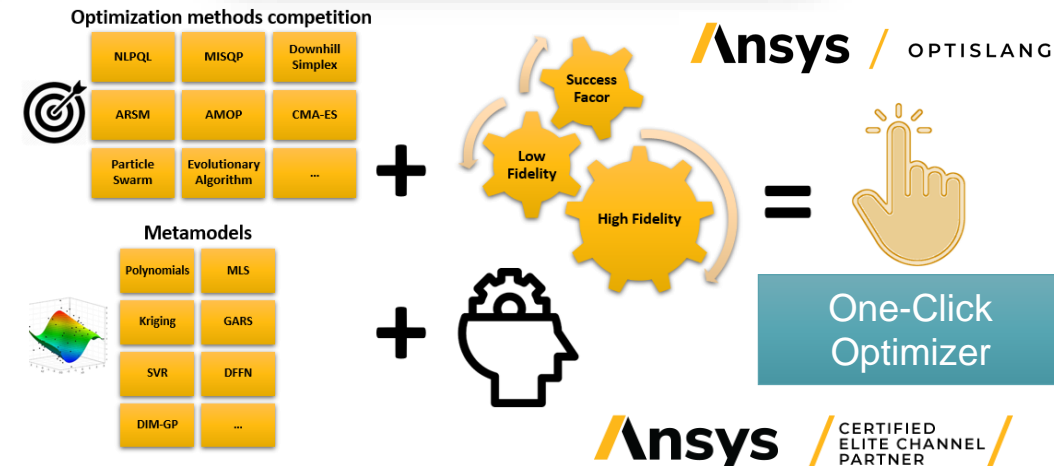
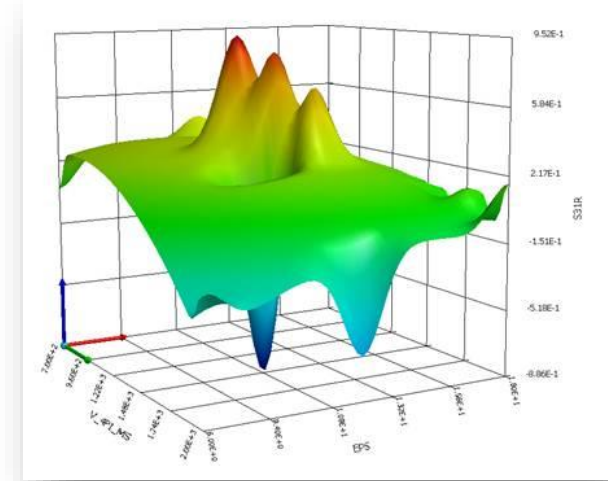
Single Point



What If?



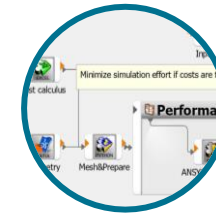
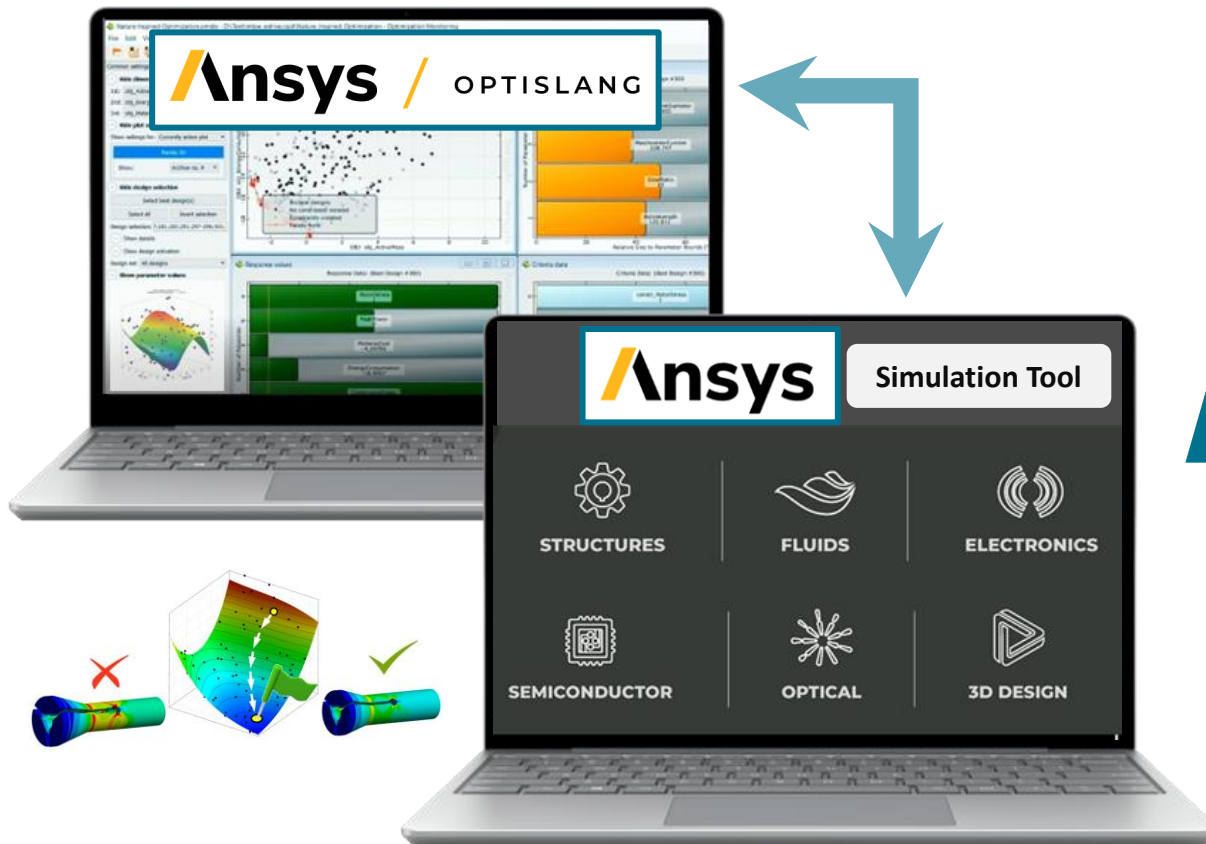
Robust Design Optimization



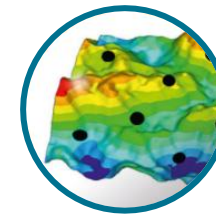
Parametric Optimization Tool: Ansys optiSLang



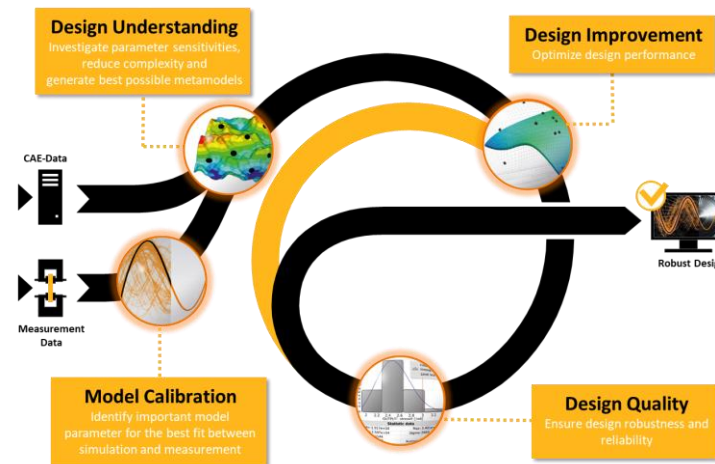
Ansys optiSLang is a framework used for **Robust Design Optimization** in combination with physics-based simulations to optimize product designs



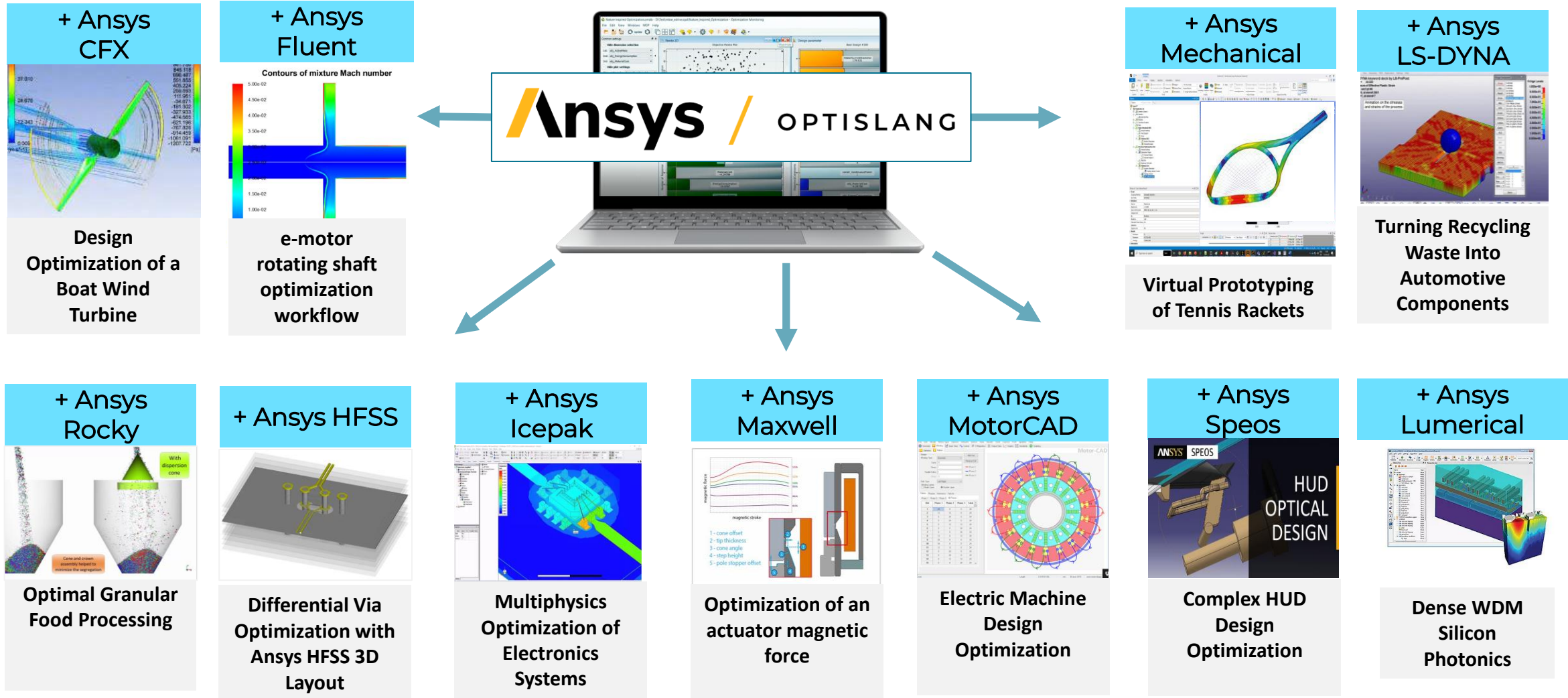
Process Integration
Build and Automate Simulation Workflows



Design Optimization
Use Algorithms for Parametric Variation Analysis



Combining Ansys Physics Solvers with optiSLang



Process Integration and Design Optimization



Automation

Parametric Variation Analysis

**Automated
Workflows**

**Model
Calibration**

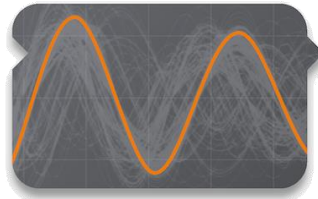
Sensitivity
Design Understanding

Optimization
Design Improvement

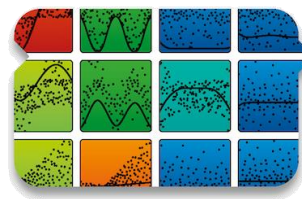
Robustness
Design Quality



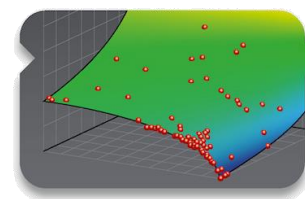
Easy to build and
publish repetitive
workflows



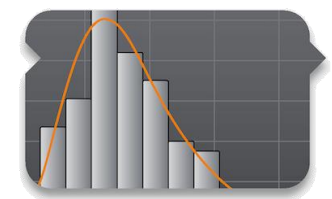
Identify important
model parameter for
the best fit between
simulation and
measurement



Investigate parameter
sensitivities, reduce
complexity and
generate best possible
metamodels



Optimize design
performance



Ensure design
robustness and
reliability

Ansys Digital Twin

Twin Builder – ROM – Hybrid Digital Twin

Digital Twin Unlocking Value



digital twin™ : “Virtual representation of real-world entities and processes, synchronized at a specified frequency and fidelity”



Real
Asset, Process or System



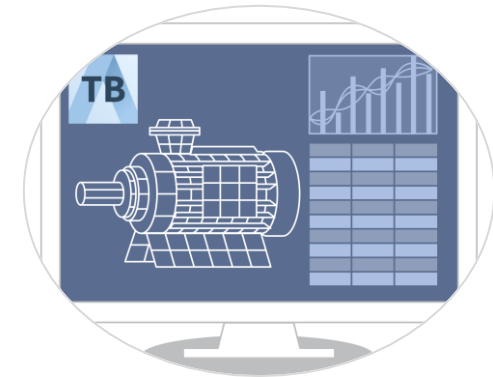
Operating variables

0101000101001101

Data/info
exchange

Actionable Insights

Digital Twin



Development

- Reduce Prototyping Costs
- Reduce Program Risks
- Reduce Time to Market

Manufacturing

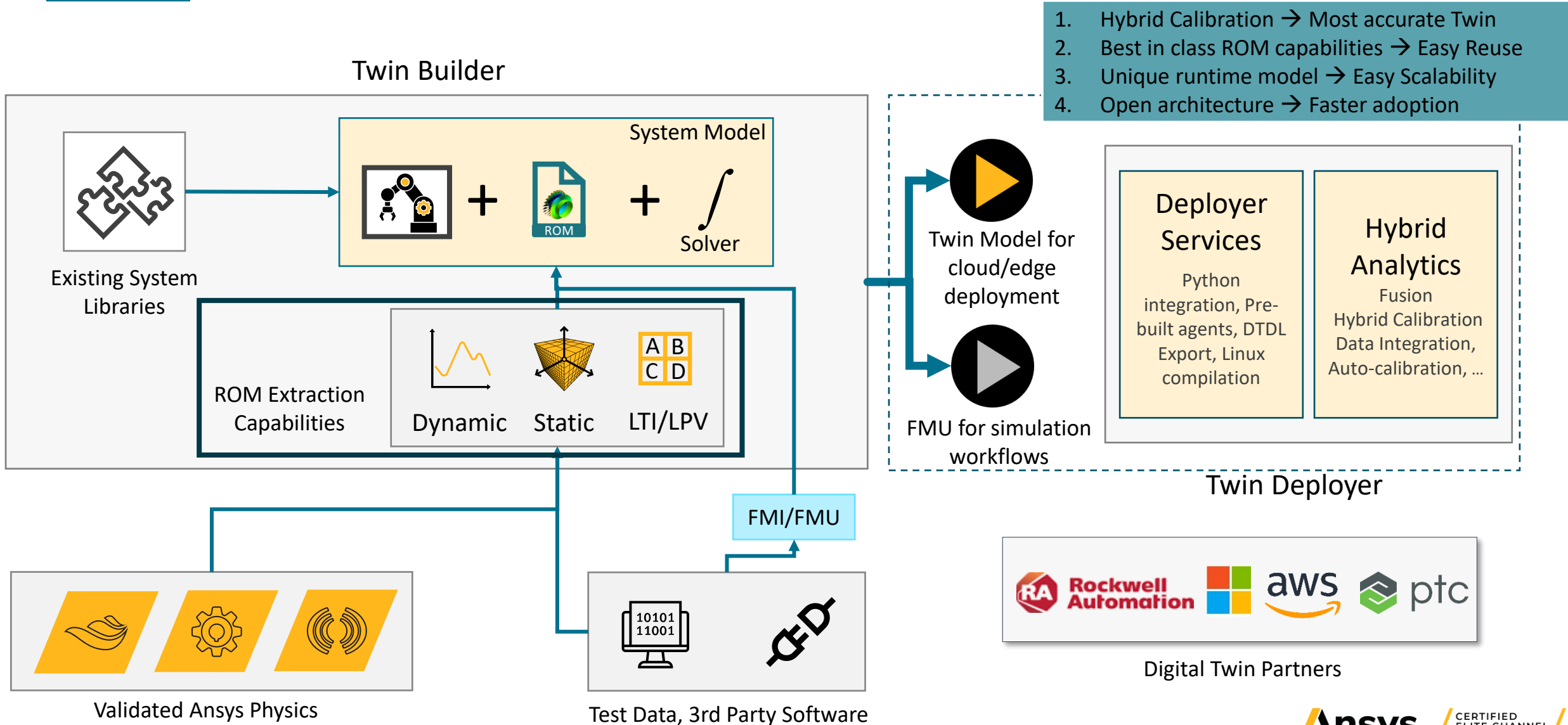
- Accelerate Commissioning
- Increase Yields & Uptime
- Reduce Manufacturing Costs

Product

- Boost Sales | Differentiation
- Reduce Warranty Costs
- Additional Revenue Stream

Sustainability Goals

Ansys Digital Twin Architecture



Reduced Order Model (ROM)



Reduced Order Model (ROM)

Model Order Reduction (MOR) is a technique for reducing the computational complexity of mathematical models in numerical simulations.

The output of this technique is a **Reduced Order Model (ROM)**.



Benefits of ROM

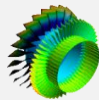
Reduced simulation time (think 10-100x)

- Ideal for Design of Experiments (DoE)/ Parameter sweep
- Integration in Twin Builder for system simulation
- Runtime generation for real-time applications



Reduced storage size

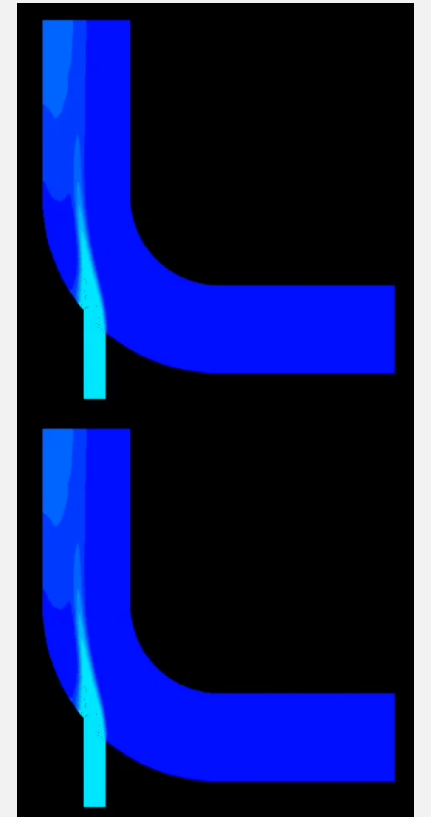
- Reduce the required storage size dramatically



Reuse 3D model

- Utilize validated 3D physics in system model
- Help increase the 3D solver footprint

Fluent CFD Simulation:
3 hours on 12 cores

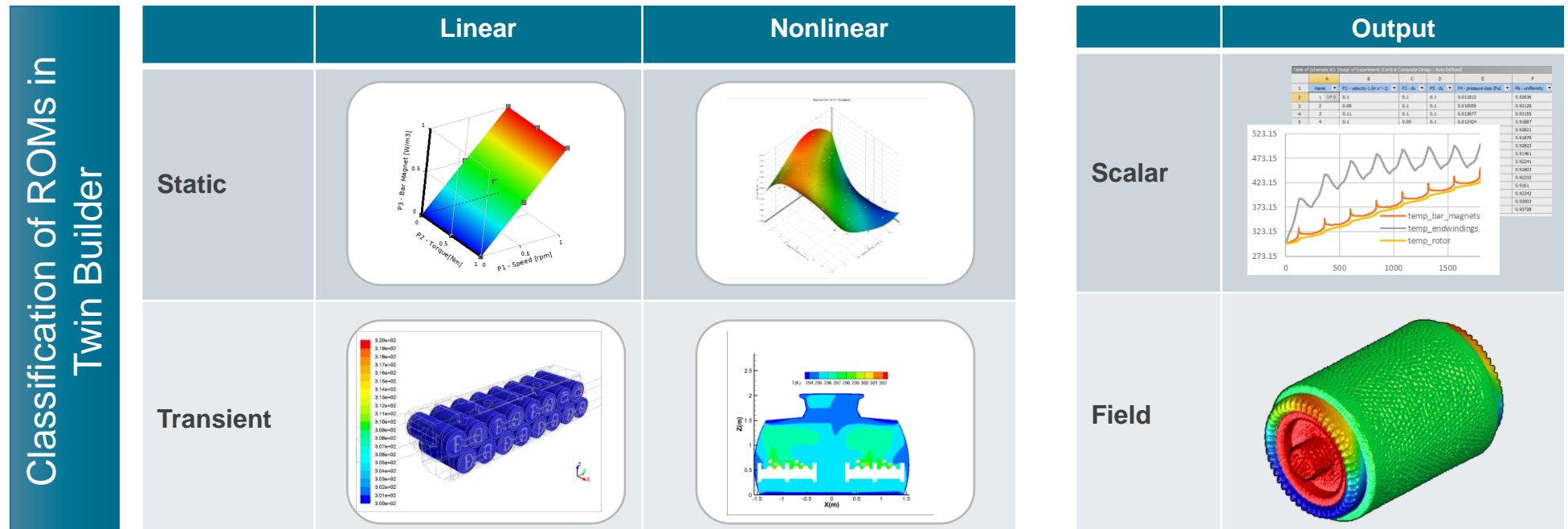
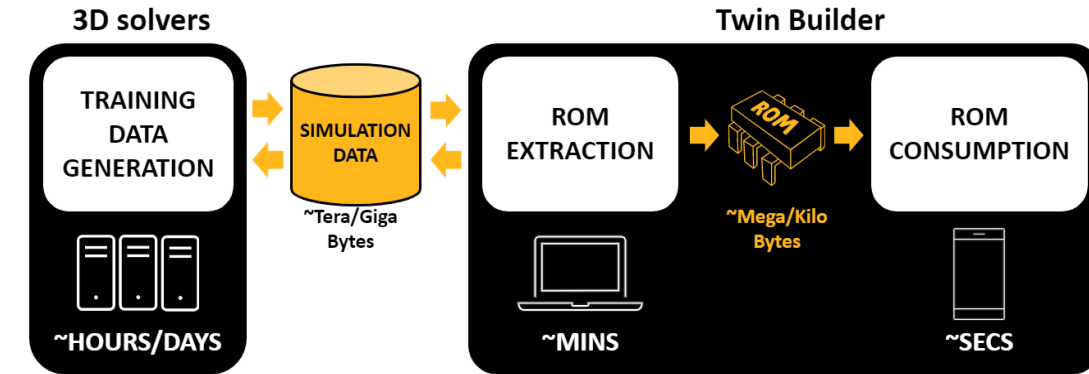


ROM Simulation
Realtime

Common ROM workflows



- Black box technology
 - It works for any mesh-based solvers (Fluent, CFX, Mechanical, Maxwell, ...)
- Machine learning workflow



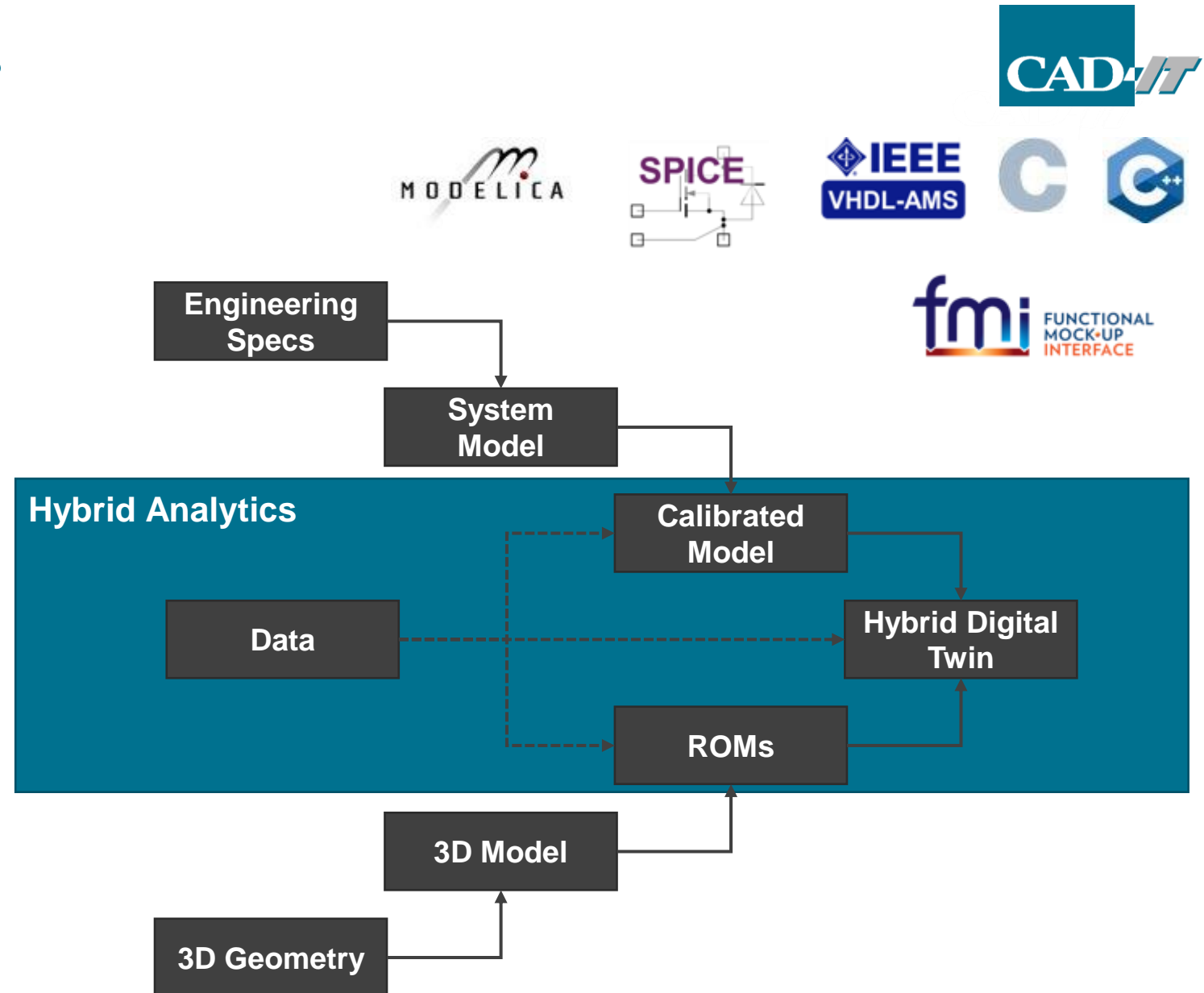
Simulation – Two Approaches

Top Down

- Accuracy is achieved through model calibration based on experimental data
- Real-time simulation achieved through light-weight system models

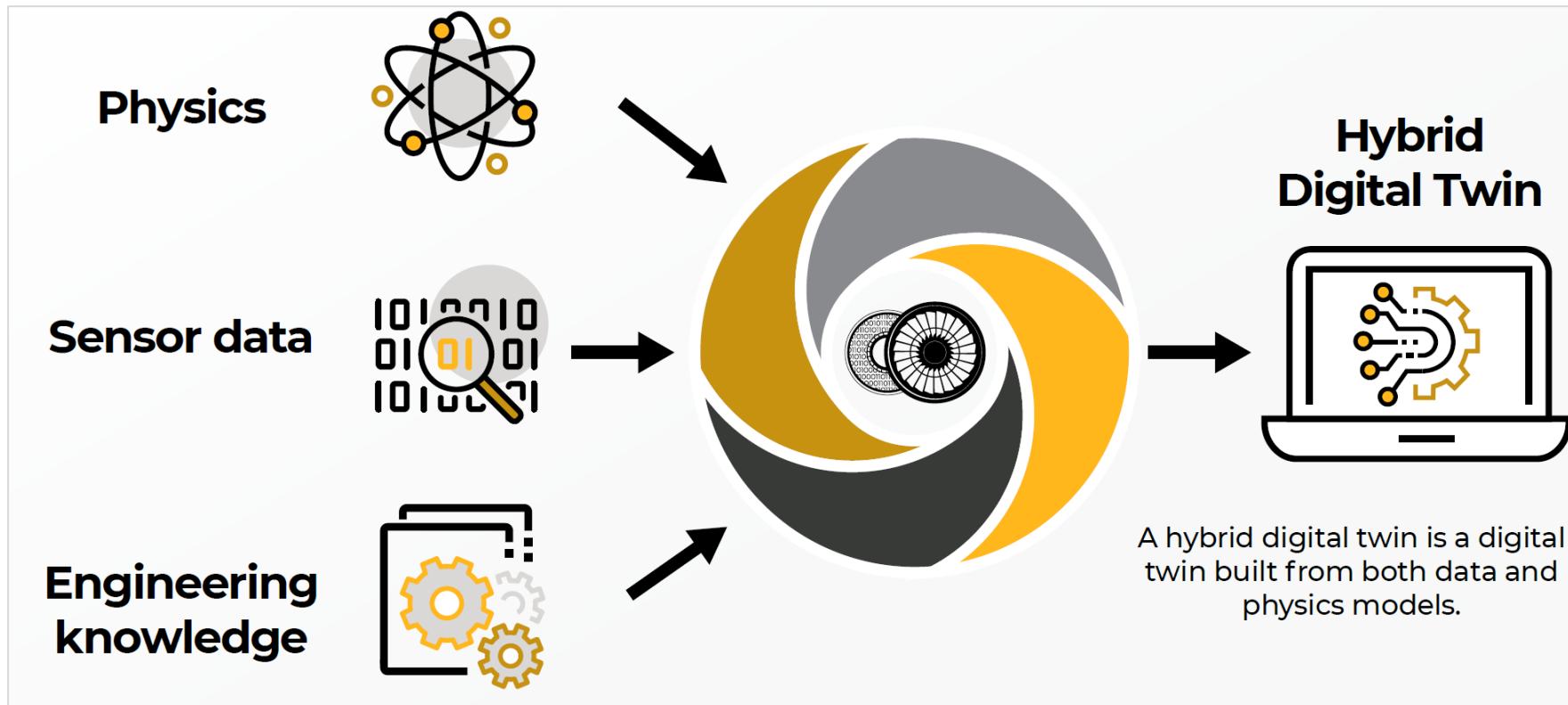
Bottom Up

- Accuracy is based on high-fidelity modeling of full physics equation and accurate geometry
- Real-time simulation achieved through ROMs



Hybrid Digital Twins: Leverage Models + Data

A **Hybrid Digital Twin** is a Digital Twin built from both data and physics models



Unparalleled
Accuracy



Uncertainty
Quantification



Fusion
Modeling



Robust
Algorithms



Easy Online
Recalibration

Ansys **AI**



Ansys AI – Transforming Simulation at the Speed of AI



AI Add-ons to Ansys products across portfolio

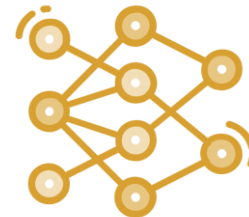


AI Add-ons to various Ansys simulation products that enhance simulation

Various Improvements



ML platform for simulation across the physics



Extremely fast and reliable physics predictions which learns from existing data

10x to 1000x Faster



Virtual assistant to Ansys products



Natural language assistant for documentation, training

Simple & Natural UX

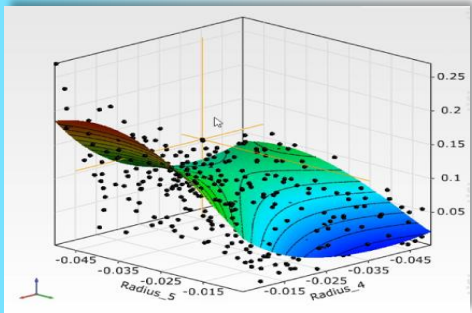
optiSLang AI+ More efficient Optimization and Robust Design



Automatic competition and creation and use of metamodels

0D: Scalars Values

MOP (*AutoML-surrogate*)
AMOP (*Adaptive DoE*)
OCO (*One-Click-Optimizer*)

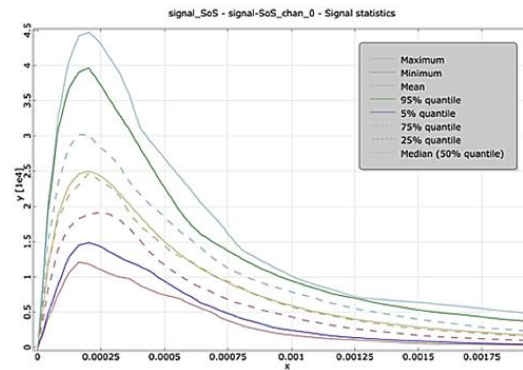


Classical technologies

*Polynomial, Kriging, Moving
Least Squares, GARS, RBF*

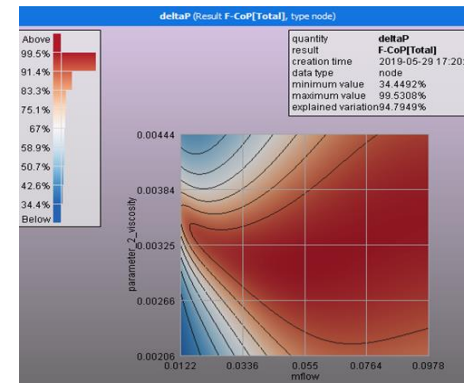
1D: Signals, Curves

Signal-MOP/AMOP



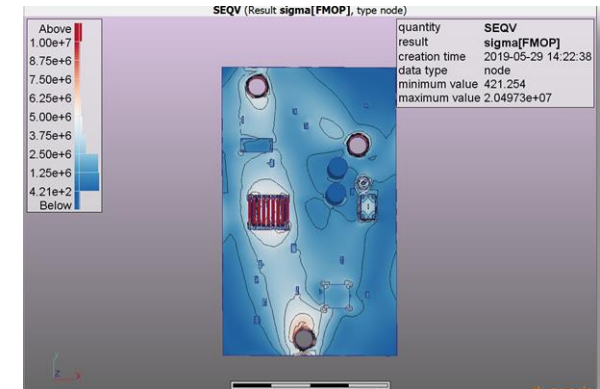
2D: Wavefronts, Performance Maps

Field-MOP/AMOP



3D: Stress fields, Deformations

Field-MOP/AMOP



Our advanced technologies



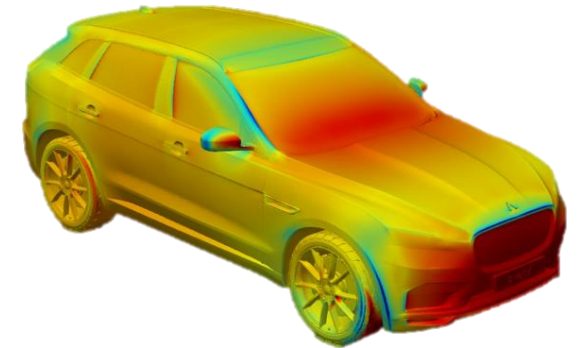
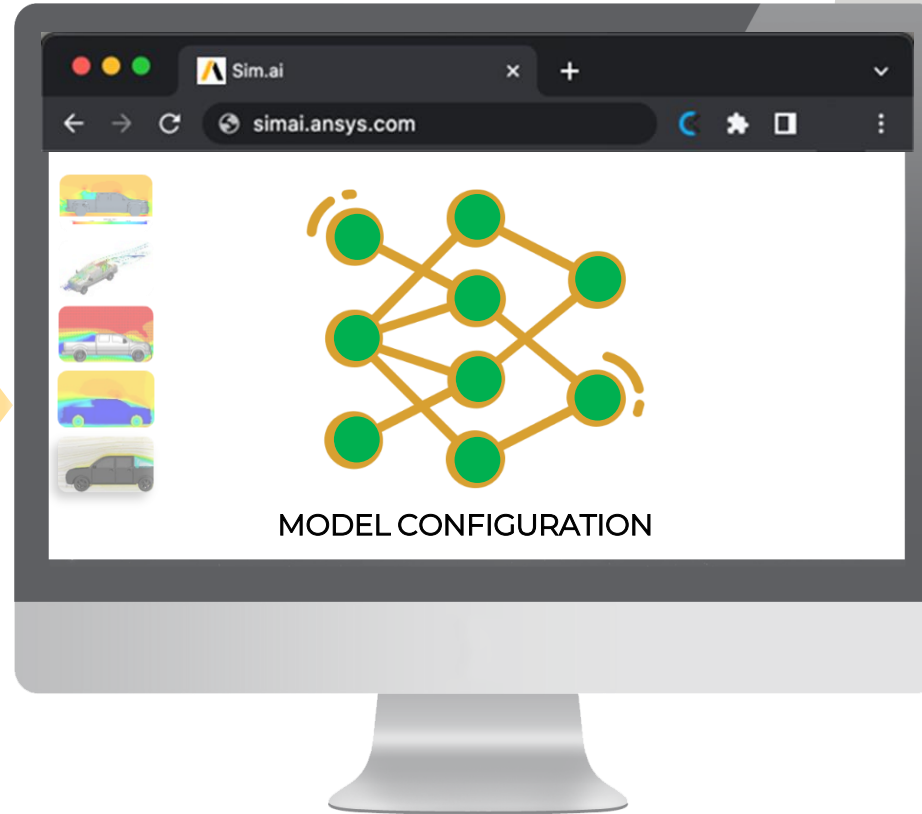
*Result Extraction, Mapping/Morphing
DIM-GP, [SVD, KL, EOLE] + MOP*



Additional advanced technologies

*DFFN, DIM-GP, SVR
ML Plugins (e.g. ASCMO)*

Predict at the Speed of AI



1- UPLOAD
Your Past Data



2- TRAIN
Your AI Model



3- PREDICT
In Seconds



Ansys SimAI – Typical Workflow



3D simulation and test results



Simulation Analyst



Test Engineer



Method Engineer



Upload your data



1min per Gb



Train your AI models



48h



Predict new designs



30s

Your catalog of trained AI models



Sedan Aero



SUV Wheel



SUV Battery



Sedan Radar



Compact Aero



MPV Crash



Micro Gearbox



SUV EMC



SUV HVAC



Sports Crash



Compact E-motor



SUV Lidar



AI prediction



Simulation Analyst



Chief Architect



Project Manager



Designer



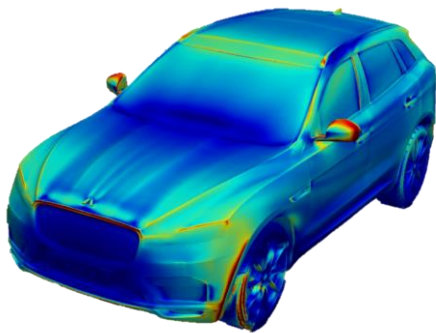
System Engineer



CERTIFIED
ELITE CHANNEL
PARTNER

Apply AI to Different Physics

Fluids

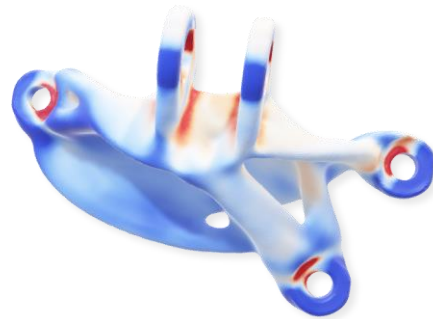


CFD comparison
Thermal management
Cooling design

Structures



Mechanical
LS-DYNA

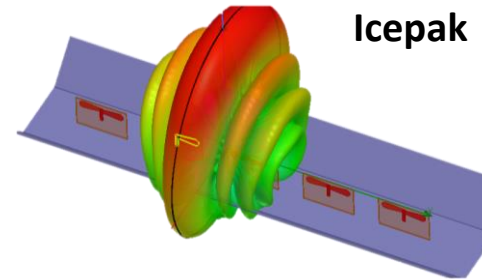


Generative design
Wire forming process
Impact performance
Crystal plasticity homogenization
Stress + deformation

Electronics



HFSS
Maxwell
Icepak

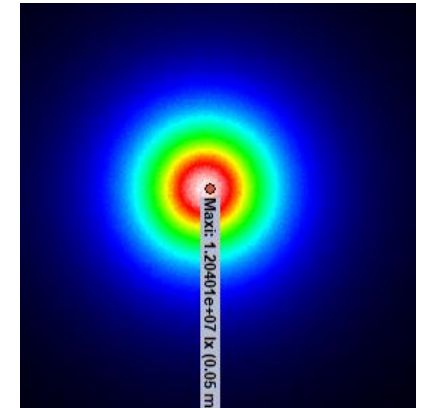


Antenna design & placement
Magnet placement
PCB EM losses and forces
Electric motor design

Optics



Speos



Illumination

Validated Use Cases – Ansys SimAI

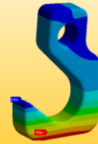


Bumper Impact Performance



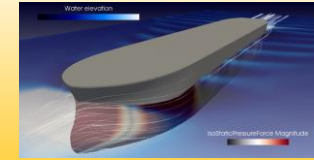
Predict safety performance across design changes faster: **>50x** compared to classical crash simulation

Crane Hook Design



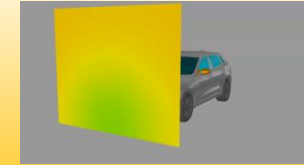
Evaluate an increased variety of hook designs : **~15x** more than conventional simulation techniques

Hull Design Exploration



SimAI resistance error compared to CFD: **less than 4%** and perfect wave pattern prediction.

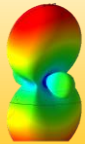
SUV Aero Performance



SimAI Prediction on new SUV geometry in **less than 1 min**

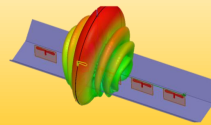


Antenna Design and Integration



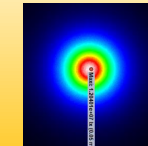
Fast answers to antenna design problems for extensive trial & error, performance optimization

Telecommunication Antenna Array



Evaluate more antenna placement topologies to drive innovation

Optical Systems in Harsh Environments



The fast evaluation capabilities of the SimAI model empower designers and engineers to explore more environments



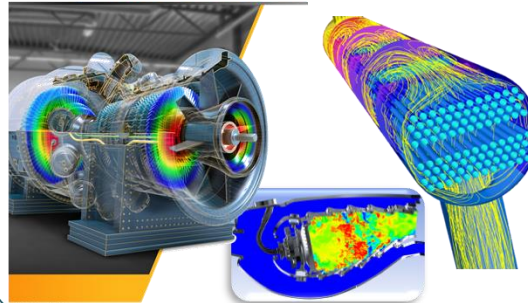
Summary

- Ansys Fluent optimizes product performance via the world's most powerful, widely known, general-purpose computational fluid dynamics (CFD) tool. Known for advanced physics modeling capabilities and industry-leading accuracy.
- Ansys Mechanical provides in-depth analysis of structural and coupled-field behaviors for broad structural analysis needs through a suite of finite element analysis (FEA) solutions.
- Ansys optiSLang is a tool for process integration and design optimization. optiSLang helps engineers and designers improve product performance, reliability, and robustness by automating the optimization process and integrating various simulation tools.
- Ansys Twin Builder enables you to quickly build, validate and deploy a digital twin — a connected replica of an in-service asset. This allows for enhanced lifecycle management and true predictive maintenance, saving costs to help maintain a competitive advantage.
- Ansys SimAI is a simulation tools, focusing on integrating artificial intelligence (AI) and machine learning (ML) techniques into engineering simulations.

THANK YOU

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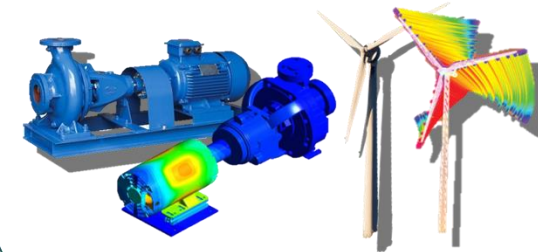
Engineering Simulation



Industry 4.0



Digital Twin

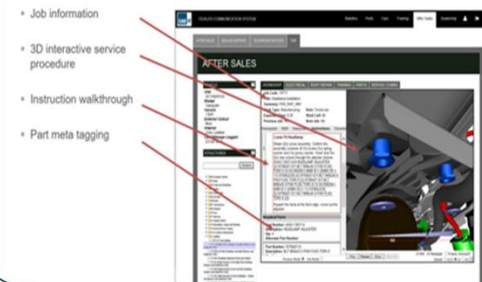


AI Telematic Devices

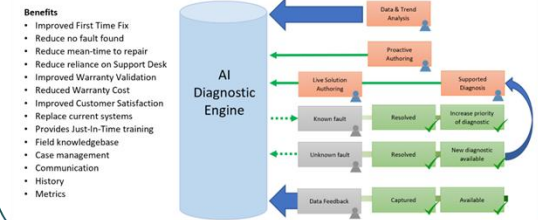


20-Jun-2024

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AI Guided Diagnostics



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