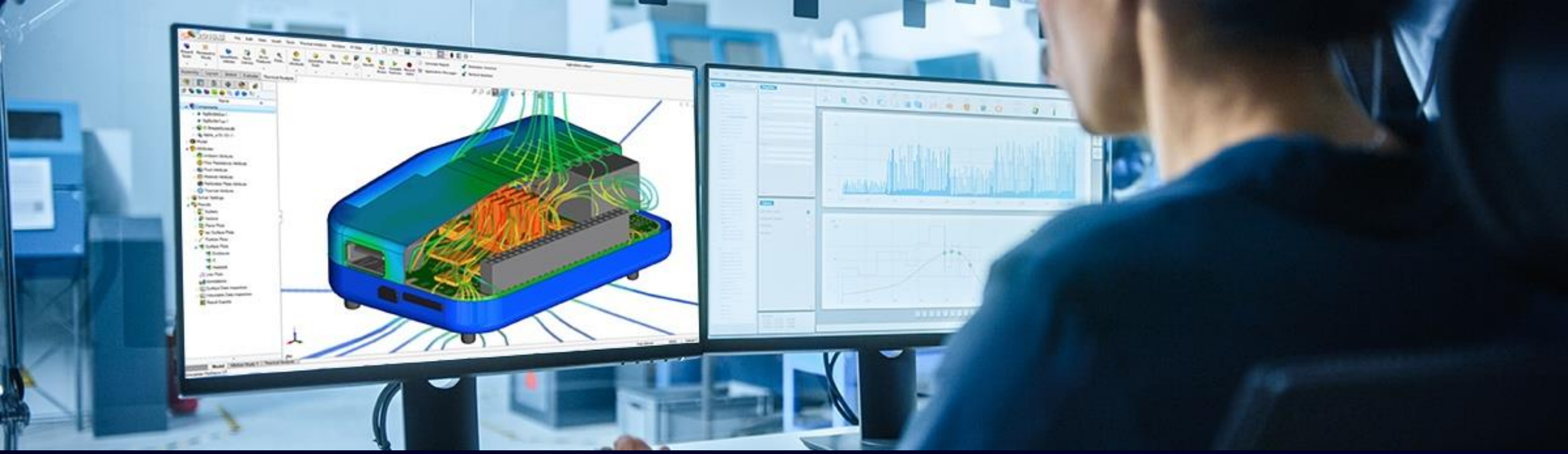
Çağrı Bostancı

Partner Sales Executive / SIEMENS

cagri.Bostanci@siemens.com



Digital Twin and Performance Engineering in the Electronics Industry

Çağrı Bostancı/ Partner Sales Executive

cagri.Bostanci@siemens.com

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Electronics is everywhere … with opportunities across multiple industries

Many different products, but with very similar challenges

Aerospace and Defense

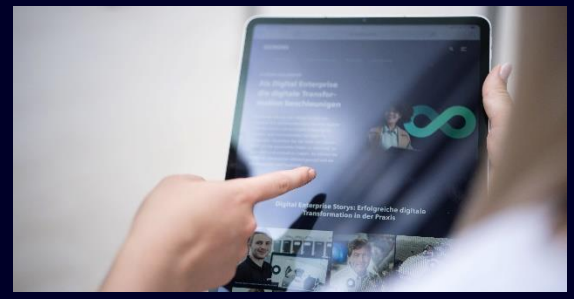
- Avionics
- Engine systems
- Control applications
- Defense electronics
- Cabin lighting
- In-flight entertainment

Medical Devices

- Imaging systems
- Therapeutic equipment
- Handheld devices for miniaturization of medical devices
- Monitors, blood, cardiac, etc.

Automotive

- Hybrid and electric vehicles
- Advanced safety features
- Connected vehicles
- Infotainment systems
- Micro mobility



Electronics[1]

- Smartphone devices
- Smart appliance technology
- Wearable technology
- Biocompatible products
- Personal mobility
- Smart city connectivity
- Industrial IOT

1 Consumer, industrial

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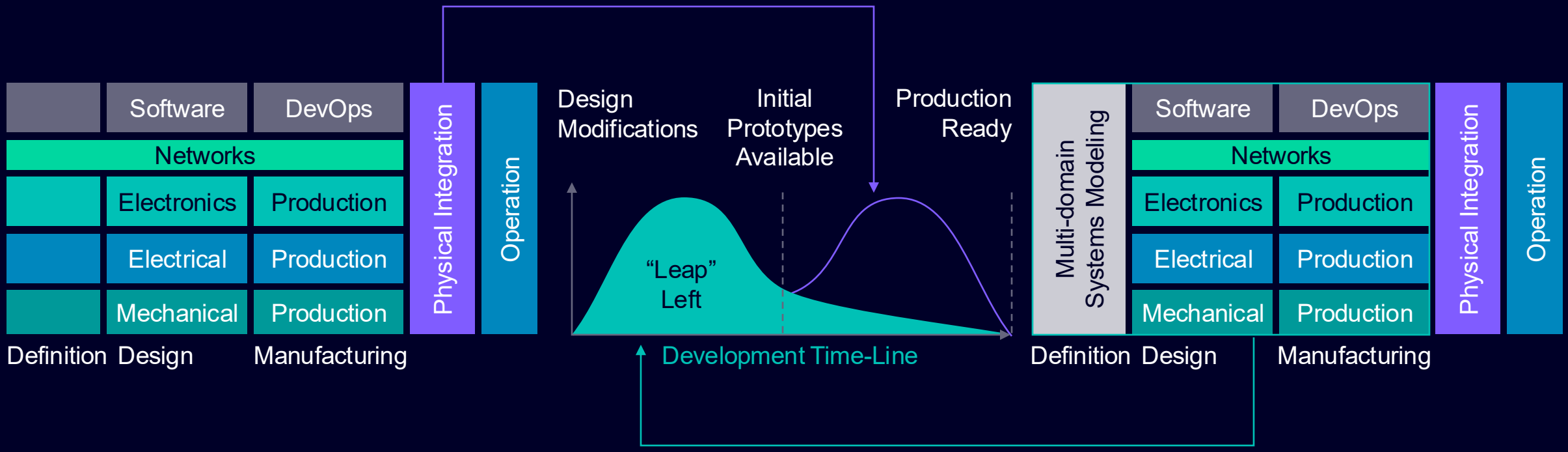
Do you have the capabilities necessary to compete
What's holding you back?

SIEMENS

What if you could transform the way you develop new products?

Today
Disconnected, manual, siloes
“Build-then-integrate”

Tomorrow
Integrated agile
“Integrate-then-build”



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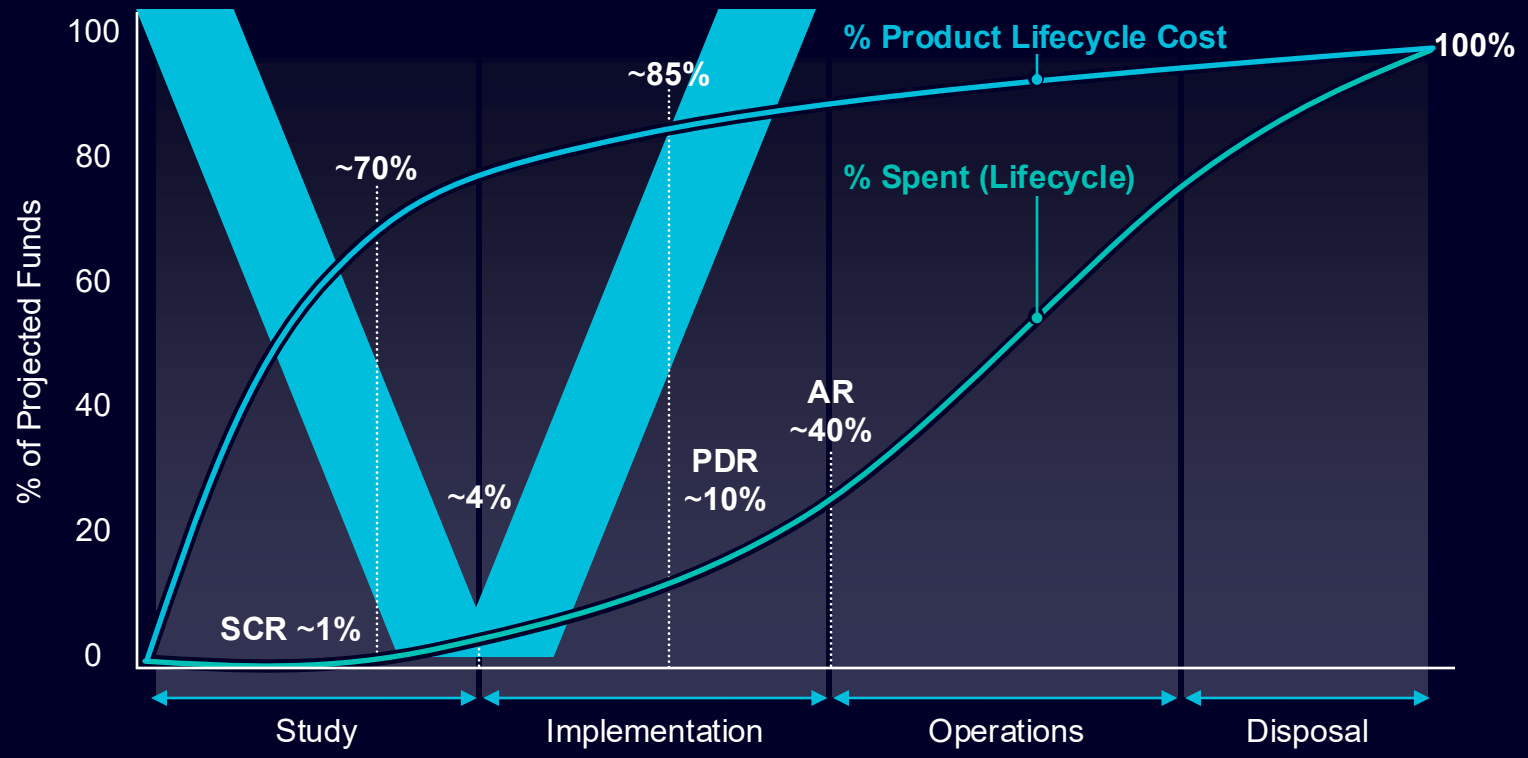
Why frontloading of simulation helps to reduce costs

Simulate, not only early, but often to keep in step with the speed of design changes

CIMdata 2022 Market Analysis Report Series
Simulation and Analysis Market Analysis Report



Engineering on the left side of the Vee typically consumes less than 5% of a program's cost but determines more than 80% of the product lifecycle cost. The implications are tremendous.

CIMdata 2022 Market Analysis Report Series Simulation & Analysis Market Analysis Report

SCR = System Concept Review
PDR = Preliminary Design Review
AR = Acceptance Review

Adapted from: Forsberg, Kevin, Hal Mooz and Howard Cotterman. Visualizing Project Management. John Wiley & Sons. Hoboken, NJ. 2005

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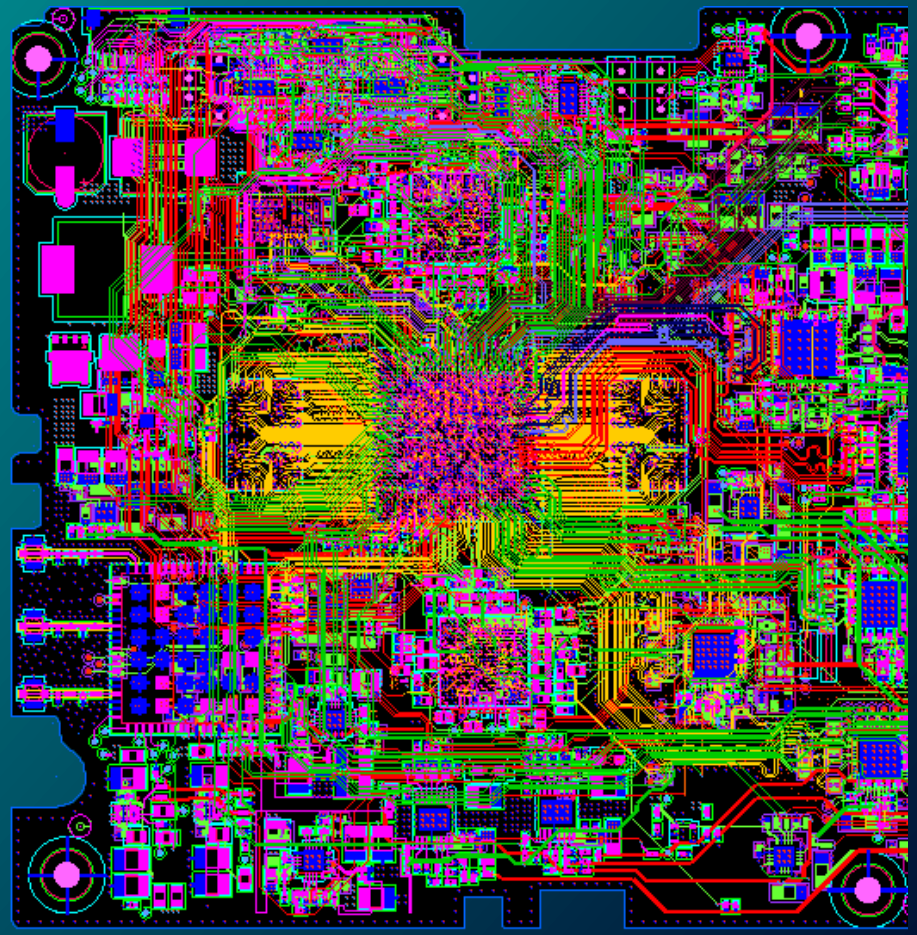
HOW CAN YOU

Reduce development time and cost, and time-to-market, while creating sustainable products?



SIEMENS

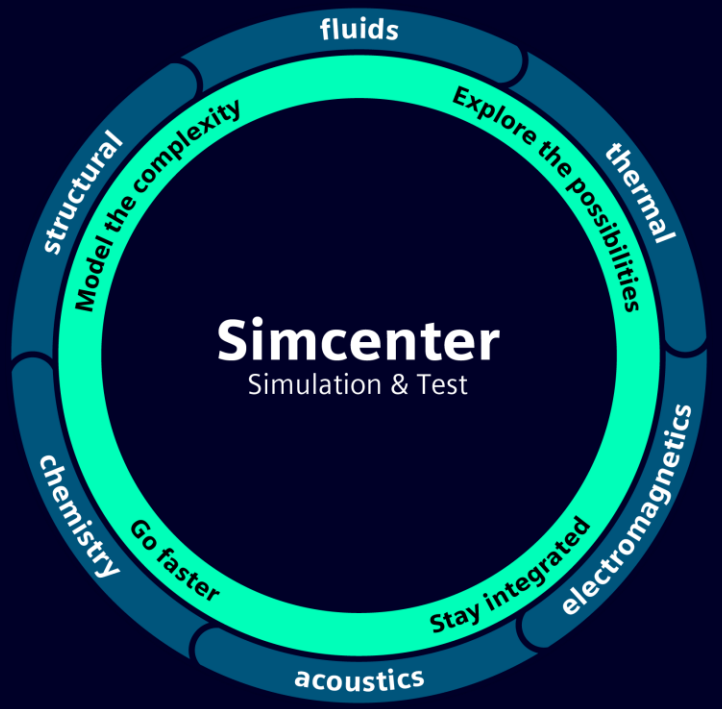
Transform Engineering
Drive productivity, empower innovation

Model the complexity
Delivering insights

Explore the possibilities
Empowering decision confidence

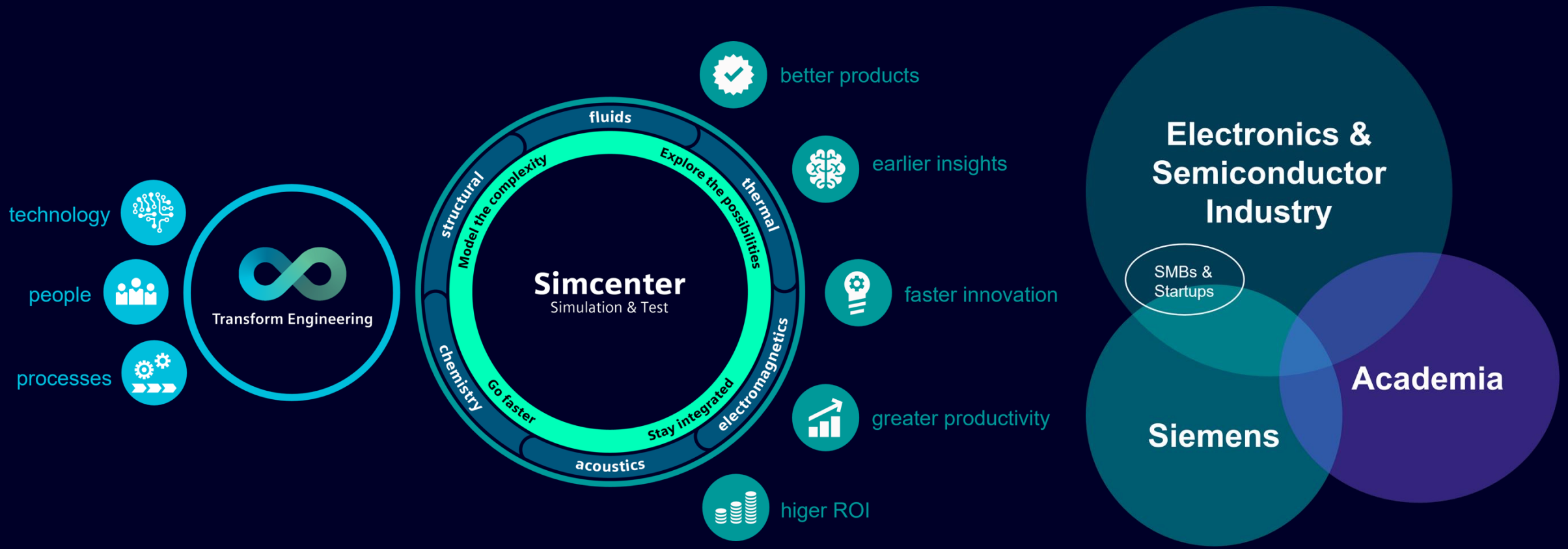
Go faster
Increasing throughput

Stay integrated
Ensuring alignment



SIEMENS

Transform Engineering
Drive productivity, empower innovation



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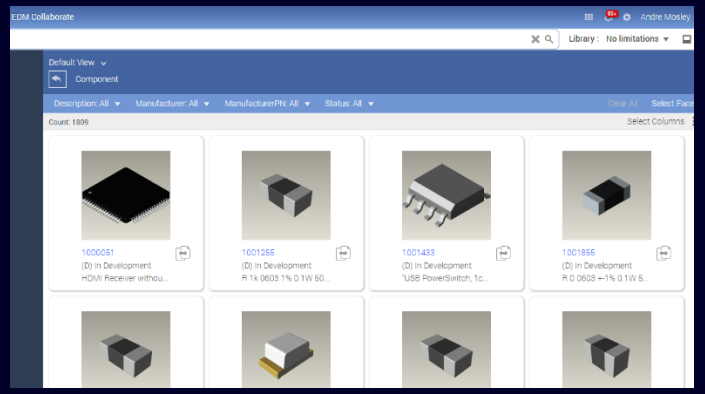
End-to-end integration to manage complexity and increase development velocity
With Siemens highly-integrated electronics workflow

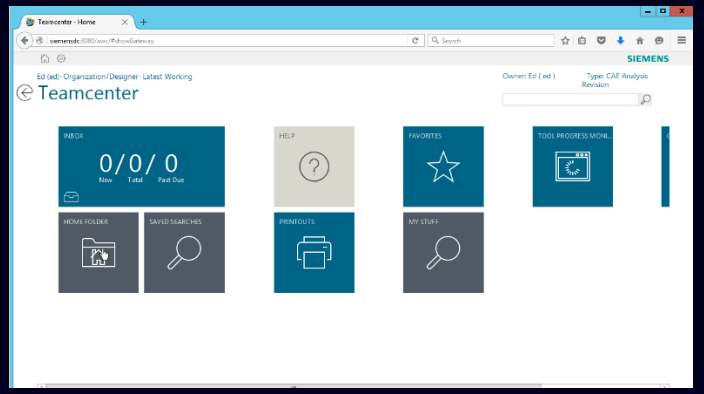
Lifecycle Management

Product data management

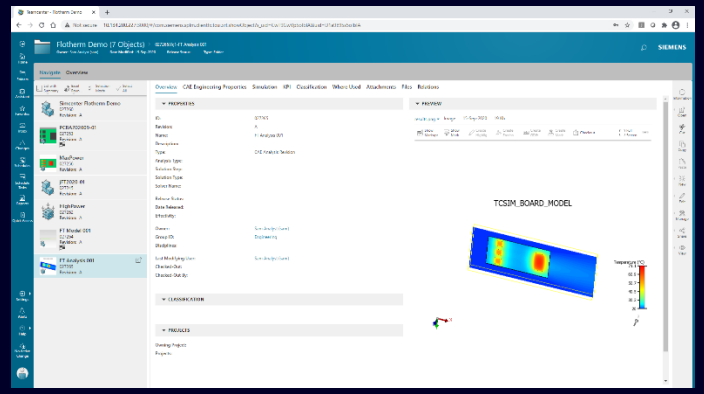
- Electronics data management
- Library data
- Collaboration



- Bill of materials
- Change management
- Cost management
- Systems engineering and requirements



- Simulation process data management
- Collaboration environment
- Guided simulation workflows



SIEMENS

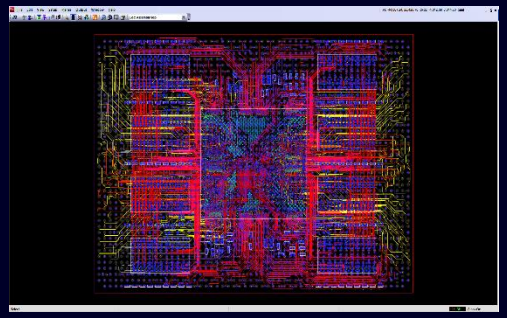
Siemens highly-integrated electronics workflow
Electronics and mechanical design integration

Lifecycle Management

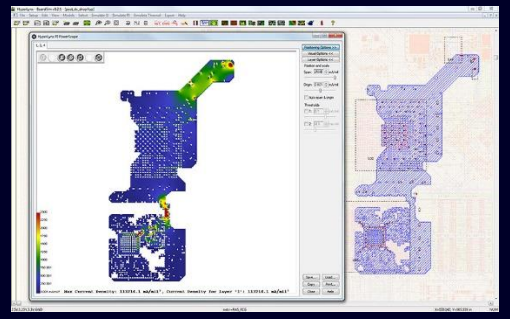
Electronics design ↔ **Mechanical design** ↔ Analyze & Explore ↔ Test, Quality & Reliability ↔ MDAO

Thermal and Power Integrity co-design

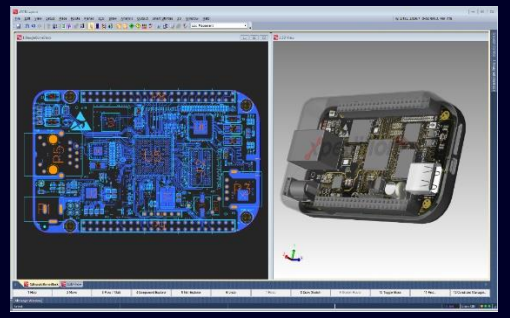
Design authoring
- Layout/Placement
- Routing
- Cabling
- Electrical DfM



- Circuit simulation
- Signal Integrity
- Parasitic Extraction



- Native ECAD-MCAD integration
- MBSE KPI tracking
- Mechanical DfM



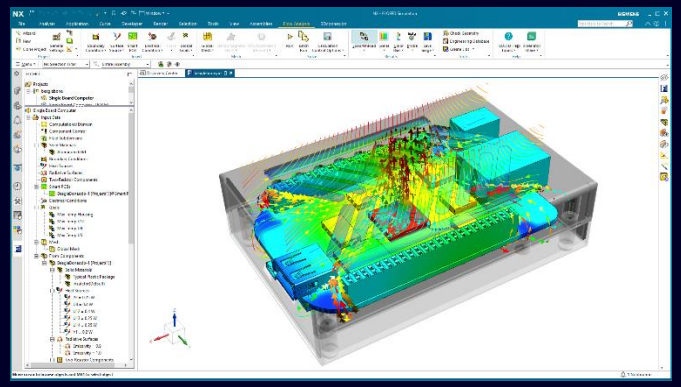
SIEMENS

Siemens highly-integrated electronics workflow
Embedded MCAD analysis

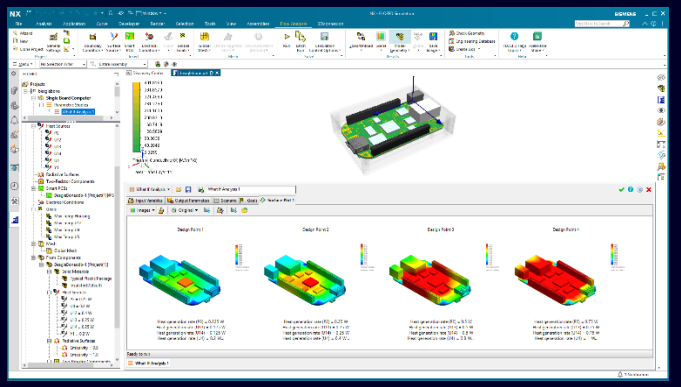
Lifecycle Management

Electronics Design | **Mechanical design** | **Analyze and explore** | Test, Quality & Reliability | MDAO

- Fluid & Thermal design within MCAD environment
- Uses native CAD with automated fluid volume detection
- No CAD simplification required
- Results displayed directly on CAD geometry



- Parametric study using parametric geometry definition
- Design of Experiment and optimization using SHERPA intelligent adaptive search



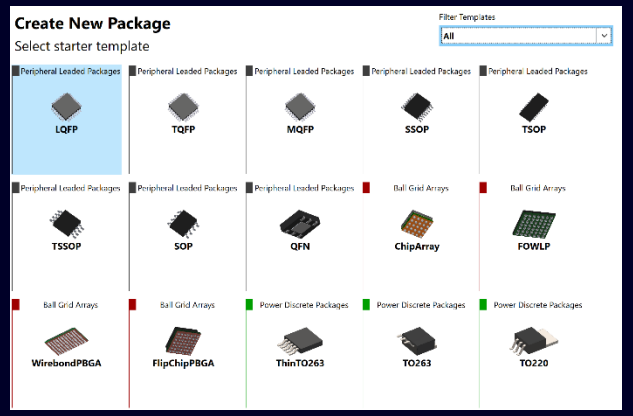
SIEMENS

Siemens highly-integrated electronics workflow
Increased fidelity with simulation and test

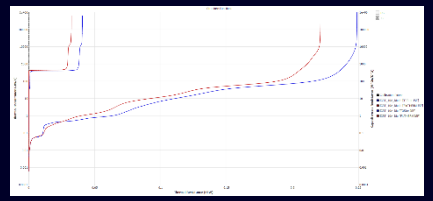
Lifecycle Management

Electronics Design | Mechanical Design | **Analyze and explore** | **Test, quality and reliability** | MDAO

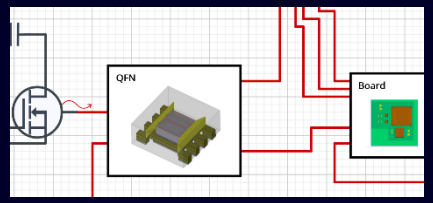
Automated generation of package thermal models



Structure Functions support automated calibration of thermal models for >98% simulation fidelity



Reduced order models protect sensitive IP across the supply chain



- Measure TIM material properties
- Thermal/optical behavior of ICs & LEDs
- Measure thermal properties of structure
- Measure reliability using power cycling
- Shaker testing & mission synthesis
- Damage mechanism cause-and-effect

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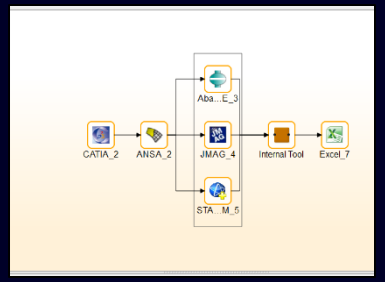
Siemens highly-integrated electronics workflow
High density advance packaging workflow

Lifecycle Management

Electronics Design | Mechanical Design | Analyze & Explore | **Test, quality and reliability** | **MDAO**

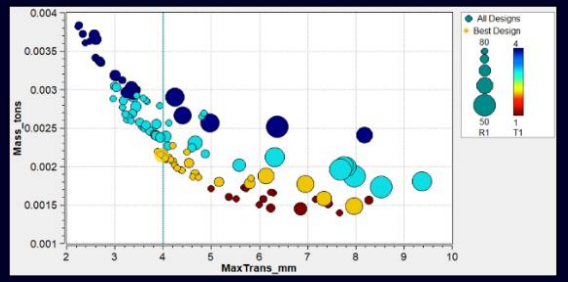
Multi-disciplinary analysis

- Open, flexible workflow automation
- Compute resource management

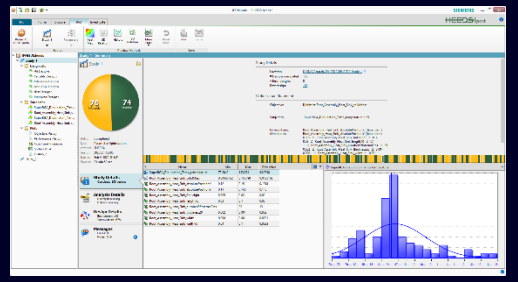


Optimize competing objectives:

- Thermal, stress, vibration, shock, electromagnetics, acoustics (noise, sound quality), etc.
- Post-processing & data analysis



- DFMEA
- Robust design



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Siemens highly-integrated electronics workflow – Summary

End-to-end integration to manage complexity and increase development velocity

Lifecycle Management (Teamcenter, Polarion, Xpedition EDM)

HEEDS Portals

Electronics design (Xpedition/Calibre)

Mechanical design (NX Platform)

Electromagnetic, thermal and structural analysis (NX & Simcenter; embedded HEEDS)

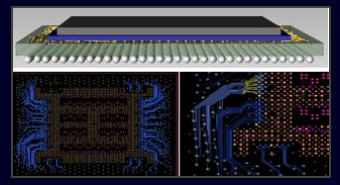
Characterize, test quality and reliability (T3STER, Power & Quality Tester)

MDAO: Automate, explore and optimize (HEEDS)

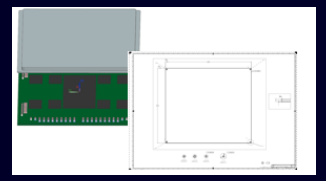
2-way exchange

Simcenter 3D

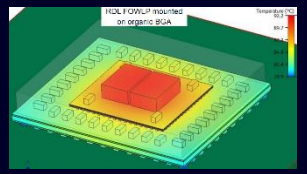
- Rapid Development of 'what-if' prototypes
- Enables system connectivity viewing and management without error-prone spreadsheets
- Flexible multi-direction flow for die, package, substrate or PCB-driven optimization



- Bi-directional MCAD-ECAD collaboration workflow
- 2D/3D clearance checking
- Characterize materials for simulation
- Advanced modeling, surfacing, and drafting capabilities

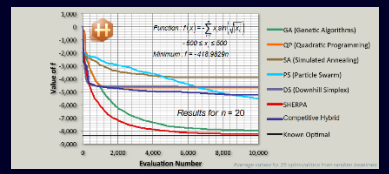


- Comprehensive die and package level extraction
- Detailed thermal modeling from die to system level
- Analyze durability against drop, shock, vibration, etc.
- Noise and acoustics
- Unique ROMs support supply chain



- Non-Destructive test
- Identify infant mortality and future failures
- Integrated with original thermal model to update data and assumptions
- Test quality during manufacture

- Multi-disciplinary design analysis and optimization using SHERPA
- Automated simulation-driven design changes
- Process automation
- Distributed job execution
- Insight & discovery



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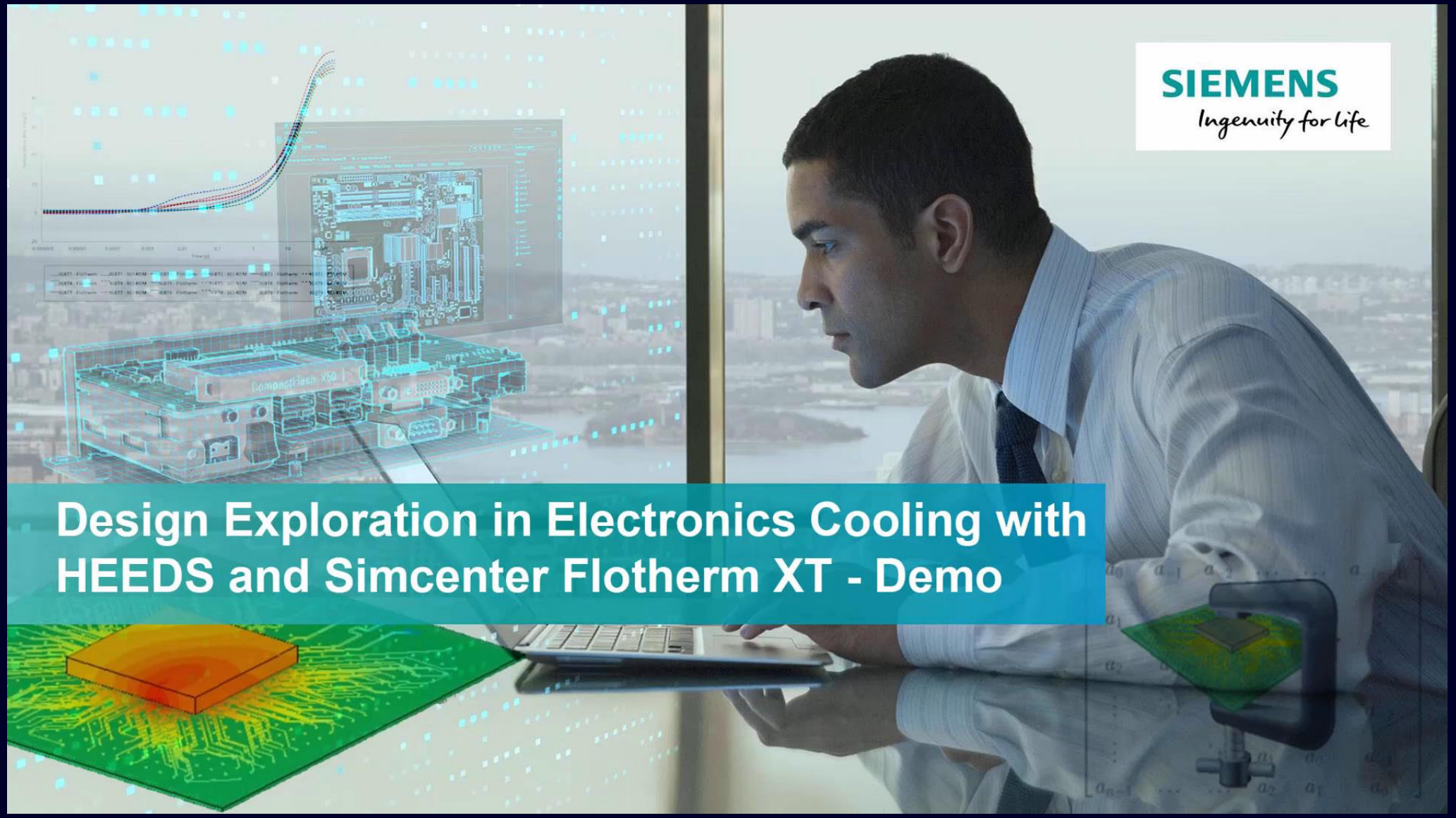


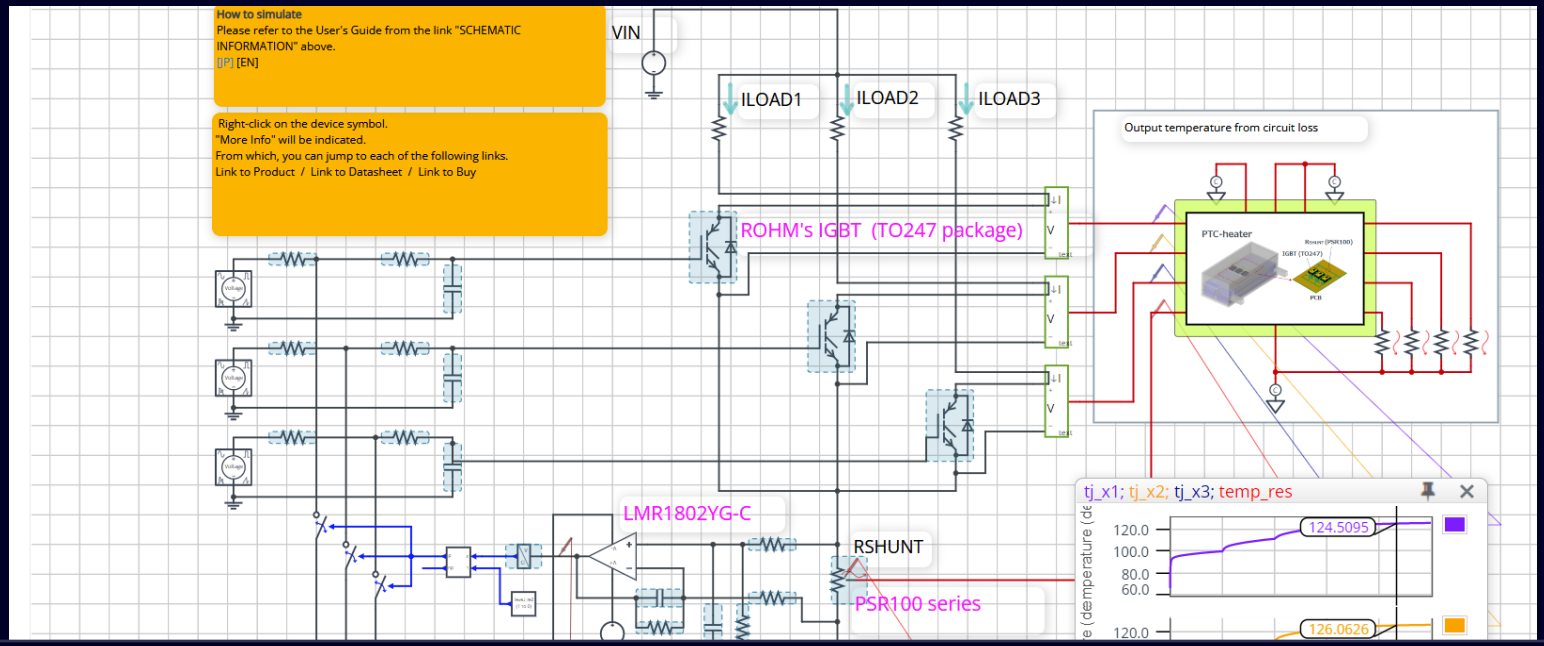
Electrothermal simulation delivers accurate power estimates in early design

Challenge

- Lack of temperature data prevents accurate power prediction, while lack of power data prevents thermal simulation
- This hampers both circuit simulation and thermal design early in the project development
- 3D thermal simulation is too slow to be used effectively in circuit design

Solution

Electrothermal co-simulation using accurate reduced order models allows consistent power and temperature prediction within a single toolset.



SIEMENS

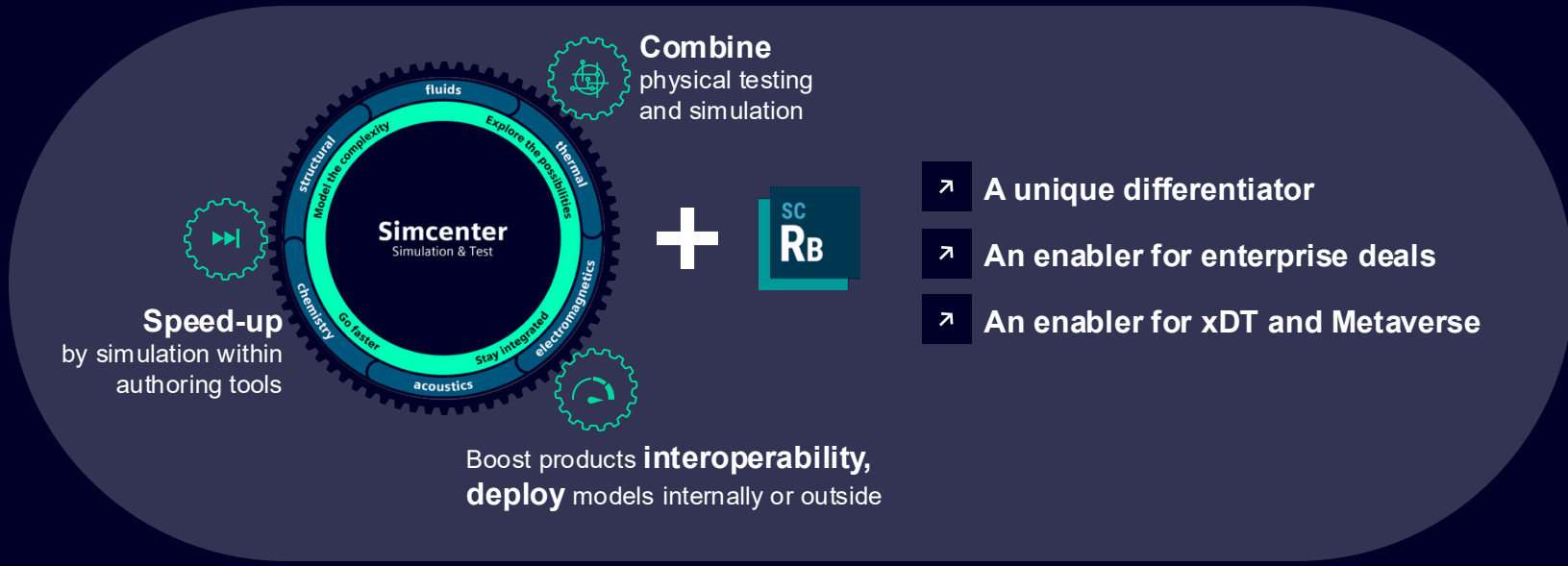
Unlock the scope of the specialized digital twin with ROM Builder

Challenge

- Companies struggle to build digital twins
- Different tools are used for different aspects of the performance
- Design decisions are made based on siloed simulation results
- Communication across development silos is limited

Solution

Simcenter ROM Builder speeds analysis with ROMs and test data, connecting domains, delivering xDTs sharable with development partners.



SIEMENS

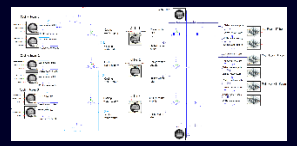
Data center energy efficiency challenges solved with system simulation

Challenge

- Energy consumption and imminent directives on carbon emissions driving need for data centers to be more sustainable
- Edge for IoT or immersive experiences require energy higher efficiency
- Increased power density and energy management from higher virtualization and AI/ML applications

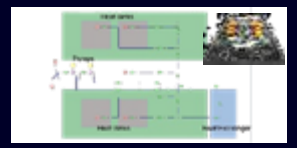
Solution

System simulation provides a holistic approach for the design, virtual commissioning, operation and refitting of data centers, IT and cooling equipment.



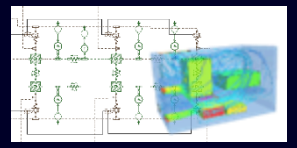
1D
Functional description

Concept



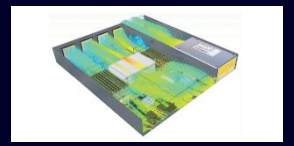
1D
Geometric description

Sizing



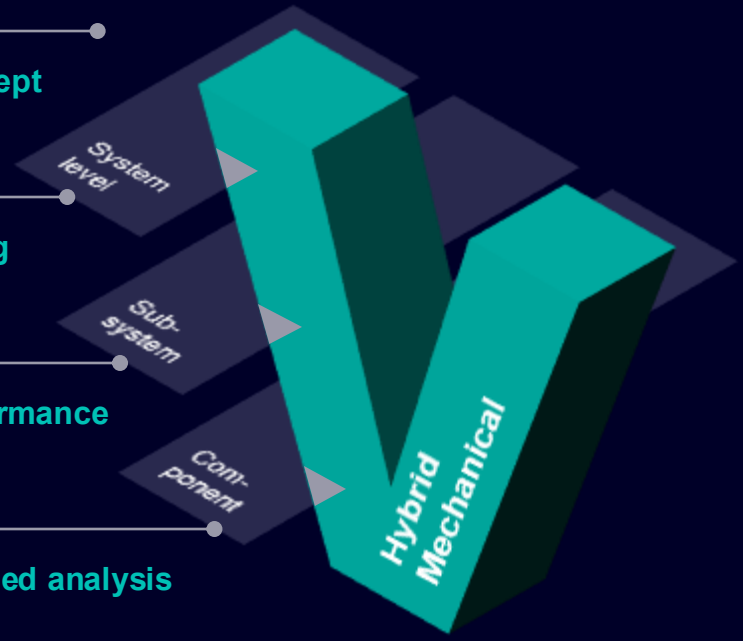
1D (+ 3D CFD)
Detailed geometry

Performance



Full 3D CFD
Detailed geometry

Detailed analysis



SIEMENS

Stay integrated

SMB

"Used together Simcenter's 1D and 3D solutions give early insight, and ease-of-use allows deployment from day 1.

Jasper Kidger
Head of Thermofluids
Iceotope Technologies Limited.

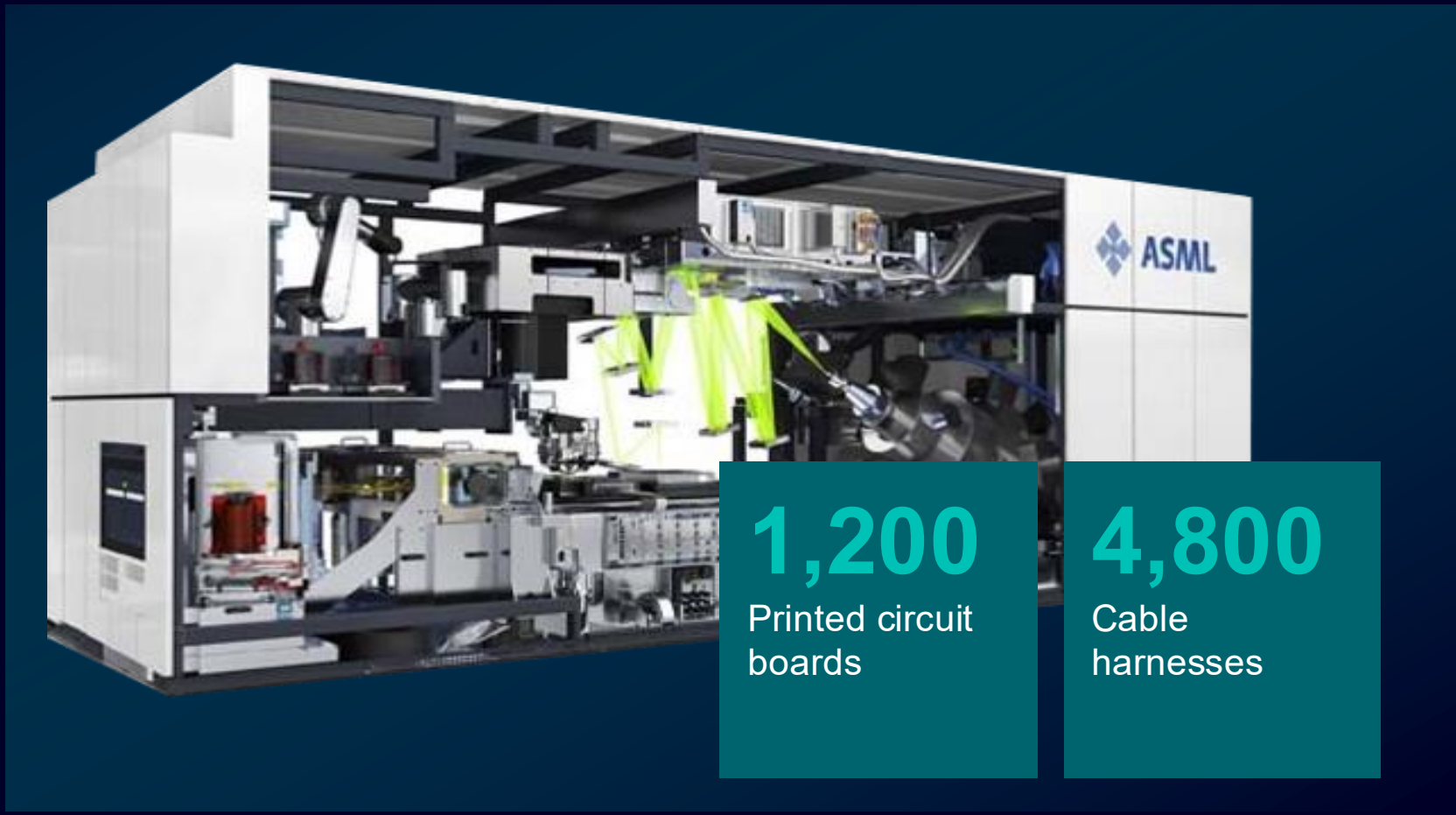
SIEMENS

Model the complexity

"

We can design connectivity from the conceptual level down to PCB layout in a single design flow in shorter time, with fewer re-spins.

ASML



SIEMENS

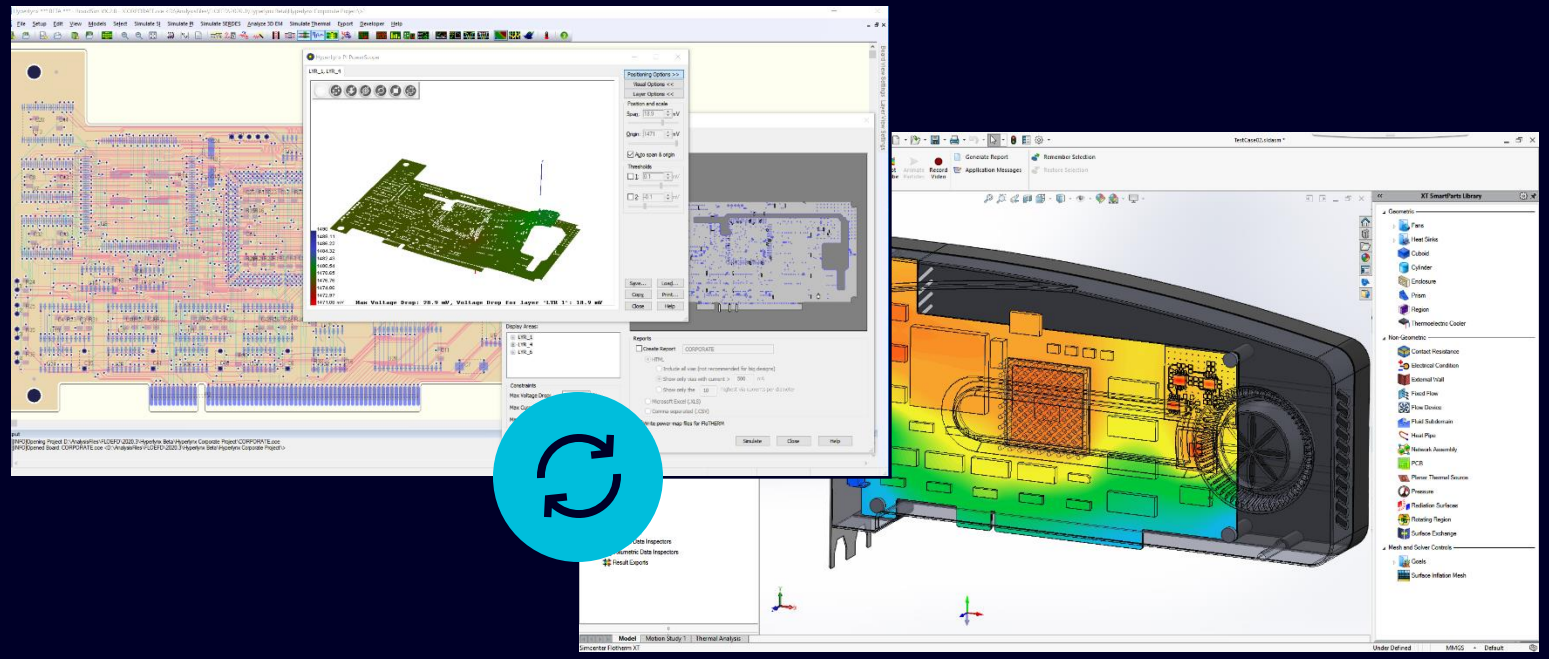
Co-simulation for accurate power integrity

Challenge

- DC IR drop simulations are not temperature-aware
- Inaccurate voltage drops arise if copper properties do not account for temperature
- Design closure may be delayed due to board re-spins

Solution

HyperLynx DC IR Drop coupled with thermal simulation in Simcenter



SIEMENS

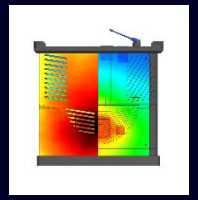
Solve electronics integration challenges by combining thermal and EMC design

Challenge

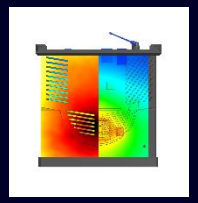
- Increasing integration and power levels in modern electronics require more potent thermal and EMC design
- At the same time electronics needs to be low cost, more sustainable and reliable

Solution

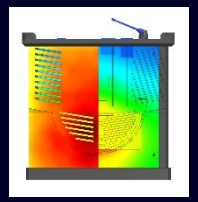
Combine thermal and high-frequency electromagnetic design in Simcenter to meet both thermal and EMC requirements!



Identify thermal challenges in your design

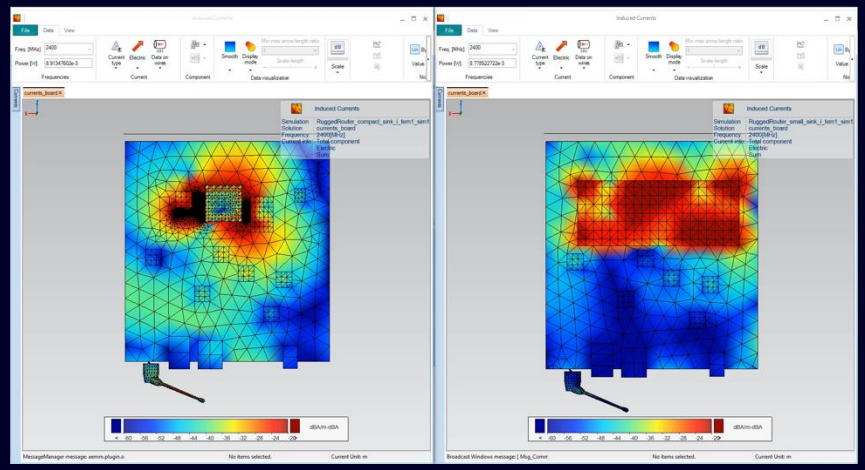


Iterate through thermal solutions



Meet both internal and external thresholds and requirements

Iterate through thermal solutions



Combine thermal and EMC design to find the optimal solution for both

SIEMENS

Boundary condition independent reduced order models
Up to 40,000 X faster

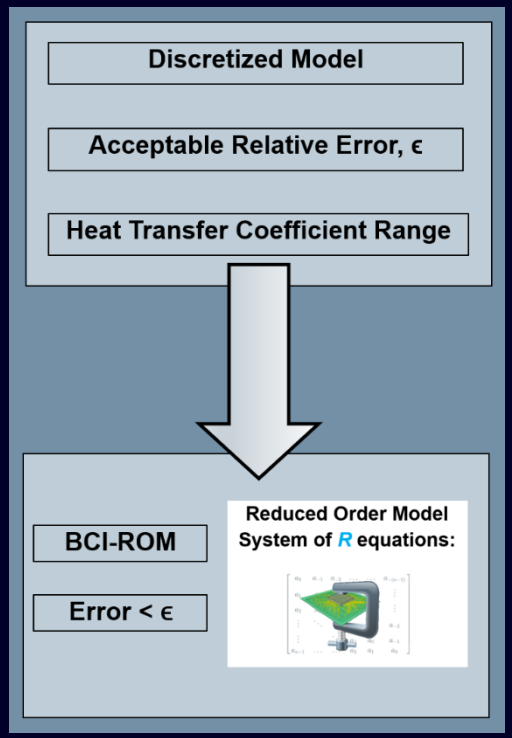
Challenge

- The electronics industry lacks a fast, accurate way to model modern multi-chip 2.5D and 3D packages in board and system level simulations
- Existing 2-Resistor and DELPHI models only consider a single heat source, and are steady-state not transient, limiting simulation accuracy

Solution

Simcenter's unique BCI-ROM technology

- Boundary condition independent
- High accuracy, known in advance
- Supports multiple heat sources
- All transient simulation timescales
- Hides internal detail (IP protected)
- Quick and easy to create
- Supports data standard formats
  - SPICE, VHDL-AMS, FMU, …
- Solves orders of magnitude faster
- Stand-alone solver available



SIEMENS

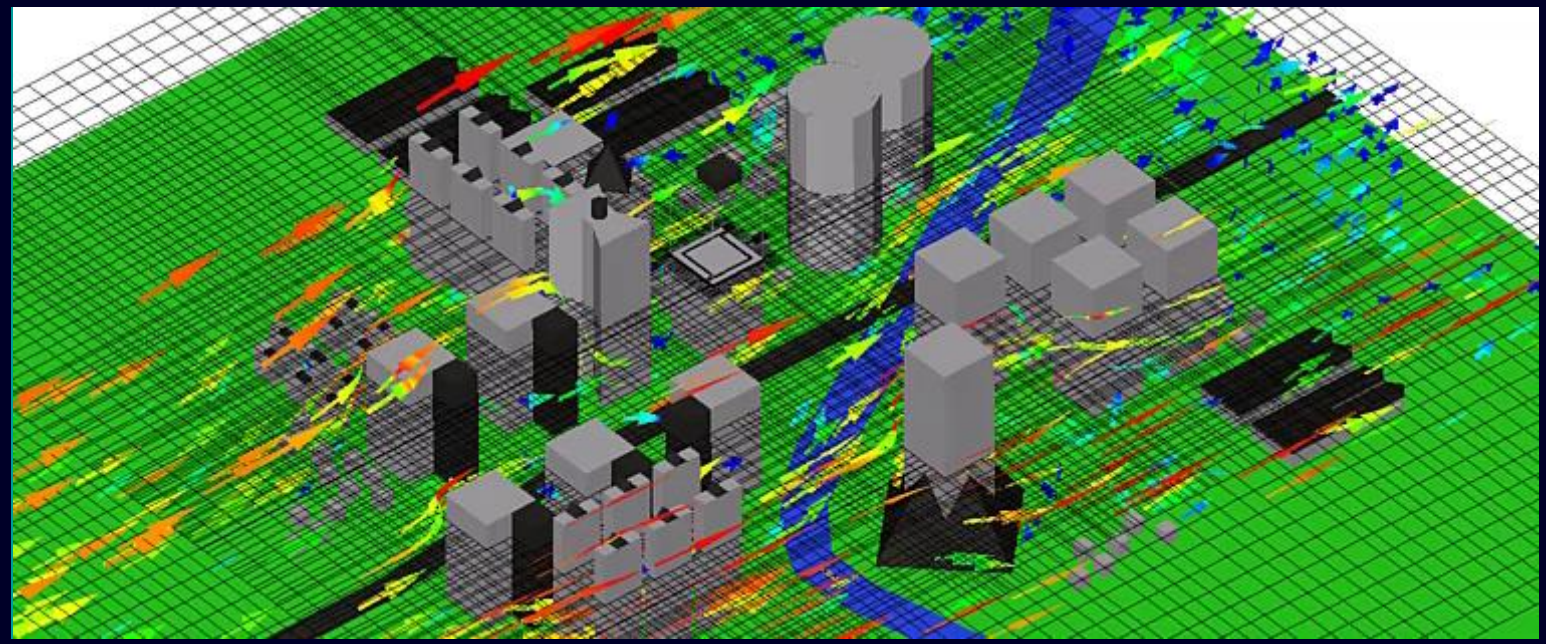
Instantaneous cartesian meshing handles massive length scale disparity in electronics applications

Challenge

- Electronics design is very fast paced
- Engineering time spend on meshing is zero value add
- Electronics have massive disparity of length scale, from sub-micro to meters, which can lead to very high mesh counts and long simulation times

Solution

Instamesh: unstructured Cartesian mesh supports high aspect ratio and size disparity.



SIEMENS

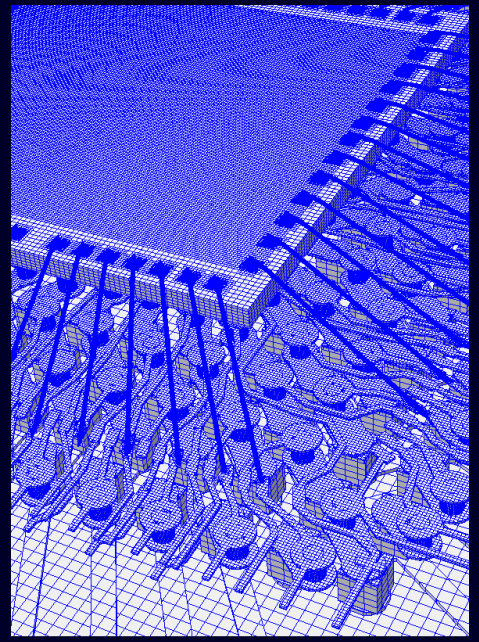
Simcenter meshing technology improves workflow speeds time-to-results without simplification

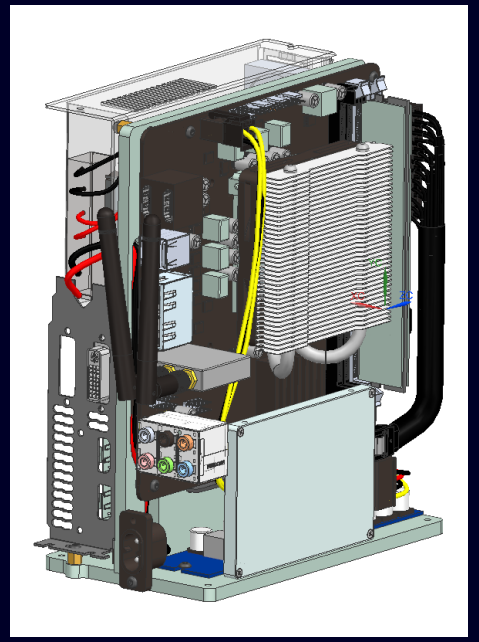
Challenge

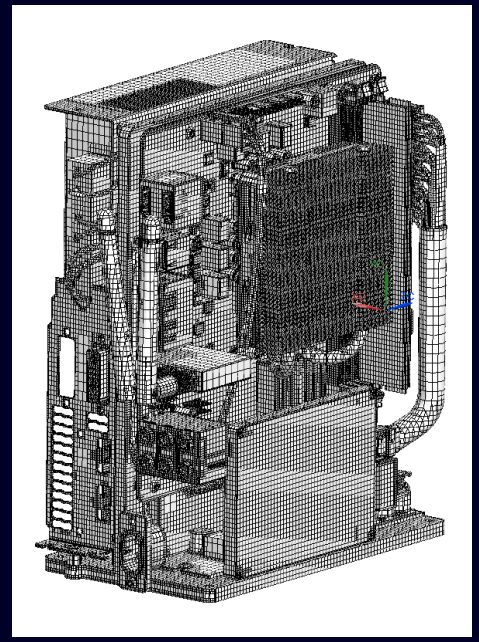
- Too much engineering time is spent fixing poor quality CAD prior to simulation
- Time pressures often force geometry simplification to make meshing tractable
- Lack of realism reduces simulation fidelity and result confidence, adding risk to the development

Solution

Octree Smartcells™ technology with local mesh-based Boolean operations eliminates the need to fix CAD errors or simplify geometry for simulation.







SIEMENS

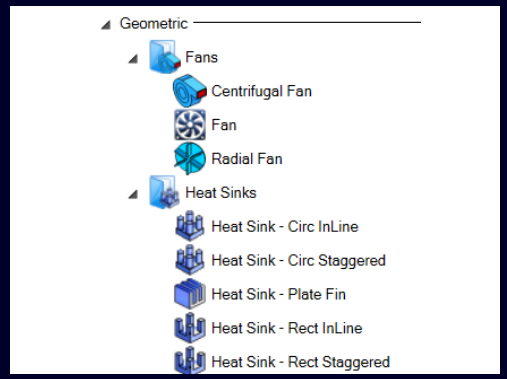
SmartParts™
Templated parametric modeling objects

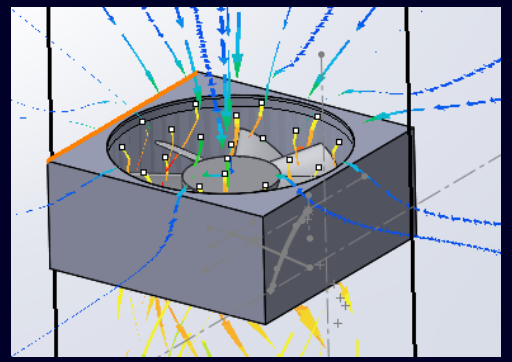
Challenge

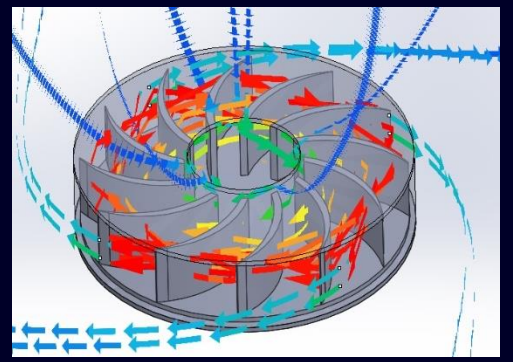
- Many thermal management components are not available as parts in CAD or EDA systems
- Available CAD does not include performance data for many electronic components, from chip packages to PCBs and fans etc. hampering performance investigation particularly in early design

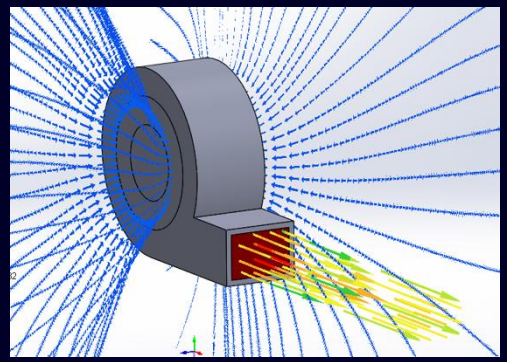
Solution

SmartParts™ are sharable intelligent modeling Objects that describe the performance of components, and other electronics parts, and include material, surface and mesh data required for simulation. This speeds development, particularly in early design.









SIEMENS

Supply chain thermal model sharing challenges solved with Embeddable BCI-ROMs

Challenge

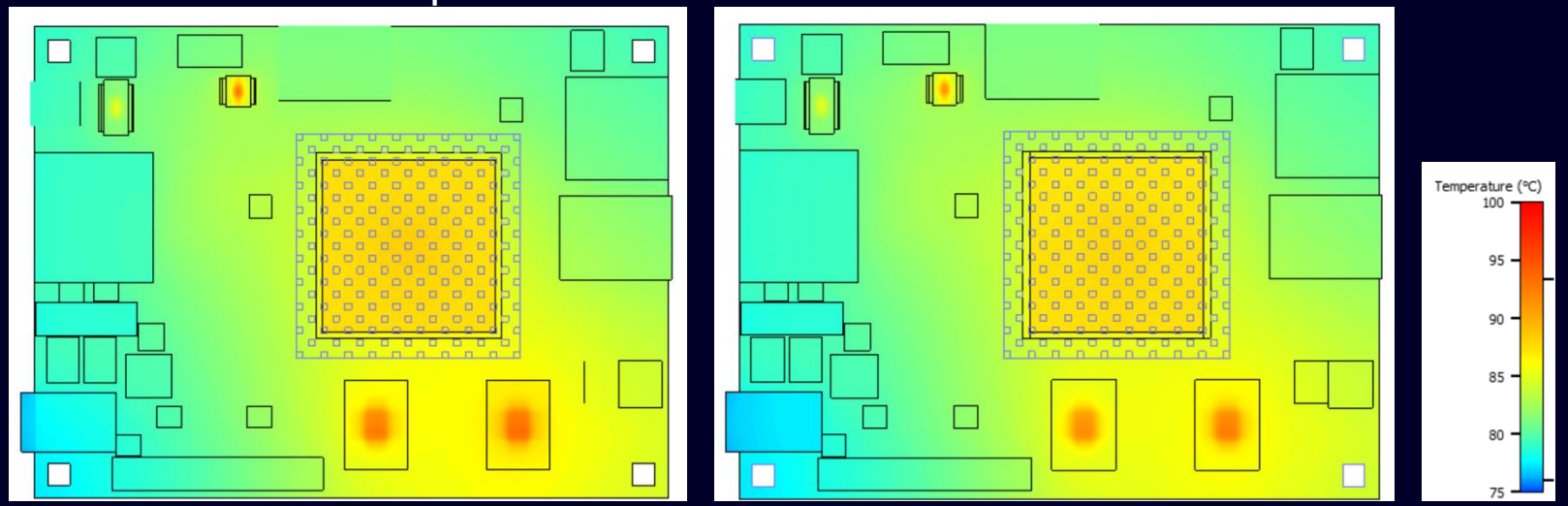
- There are no accurate, thermal models of advanced semiconductor packages for use in 3D simulation tools which protect sensitive vendor IP.
- High fidelity thermal design is hampered by the limited availability of detailed models from vendors, requiring an NDA.

Solution

Embeddable BCI-ROMs (EROMs) are impossible to reverse-engineer, are accurate for all boundary conditions, support multiple heat sources and transient simulations. Typical accuracy is ± 5% vs. a full detailed model.

All detailed components

16 embeddable BCI-ROMs

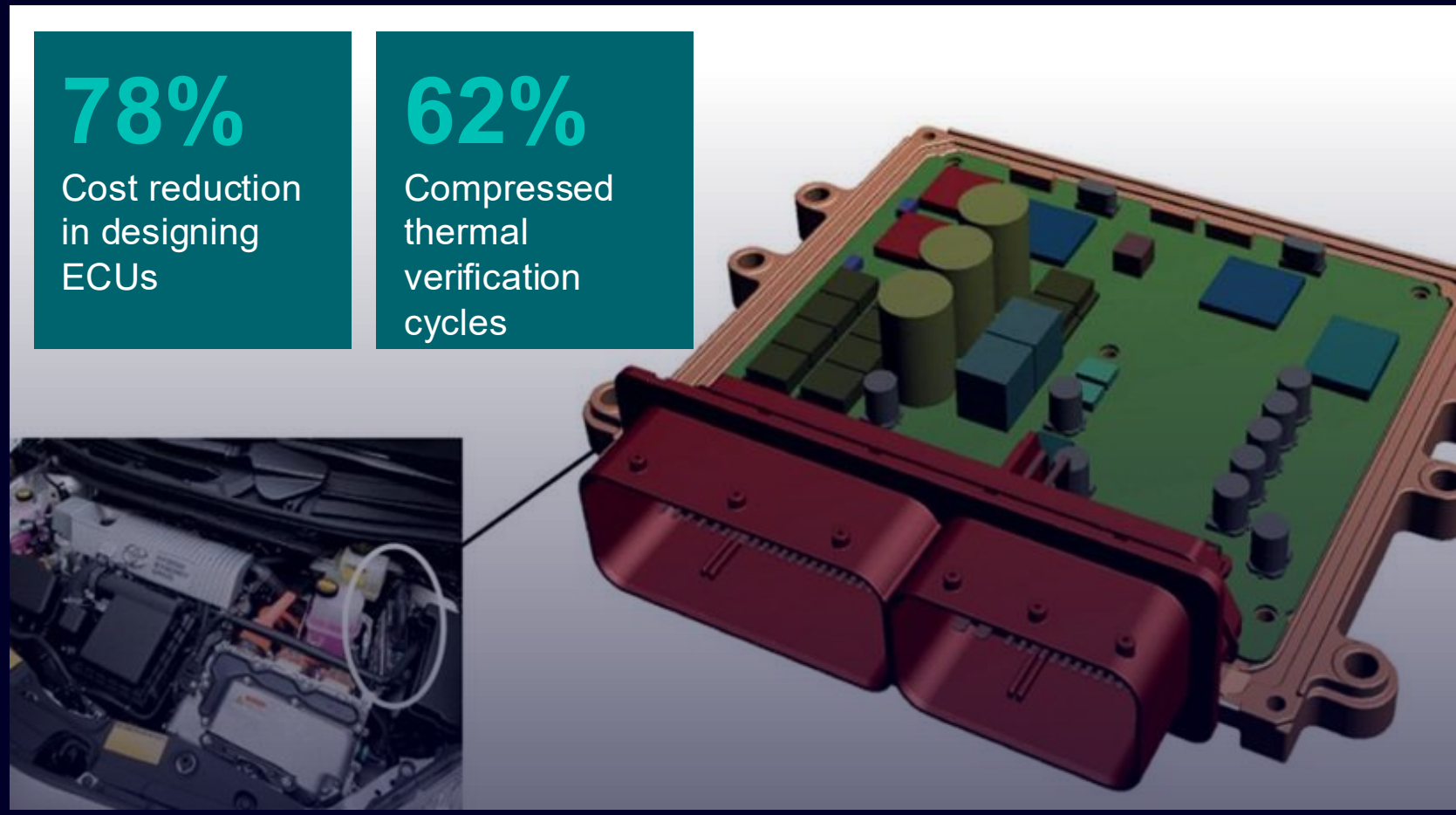


SIEMENS

Explore the possibilities

"I am tasked with continuously improving our ECU thermal performance and reducing size, weight and costs.

Takuya Shinoda
R&D
DENSO Corp.



SIEMENS

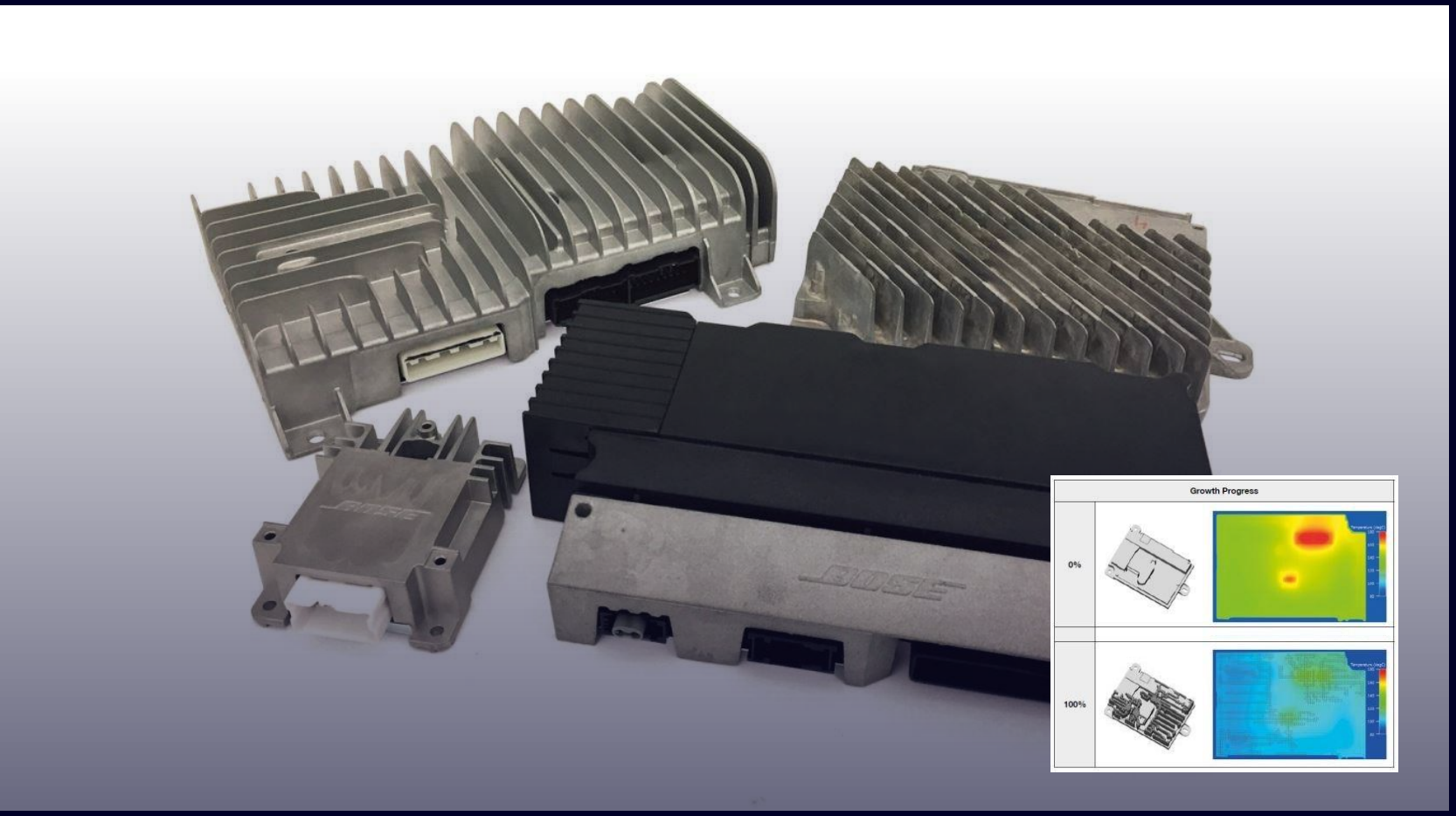
Facebook, California
Facebook’s data center server design

Data center server design reduces total cost of ownership without reducing performance

The power savings grew to 38% and the cost savings to 24%.

SIEMENS

Go faster



Simcenter helped Bose maintain its class-leading technology and deliver better products to market in less time.

55.6%

of heatsink mass removed

SIEMENS

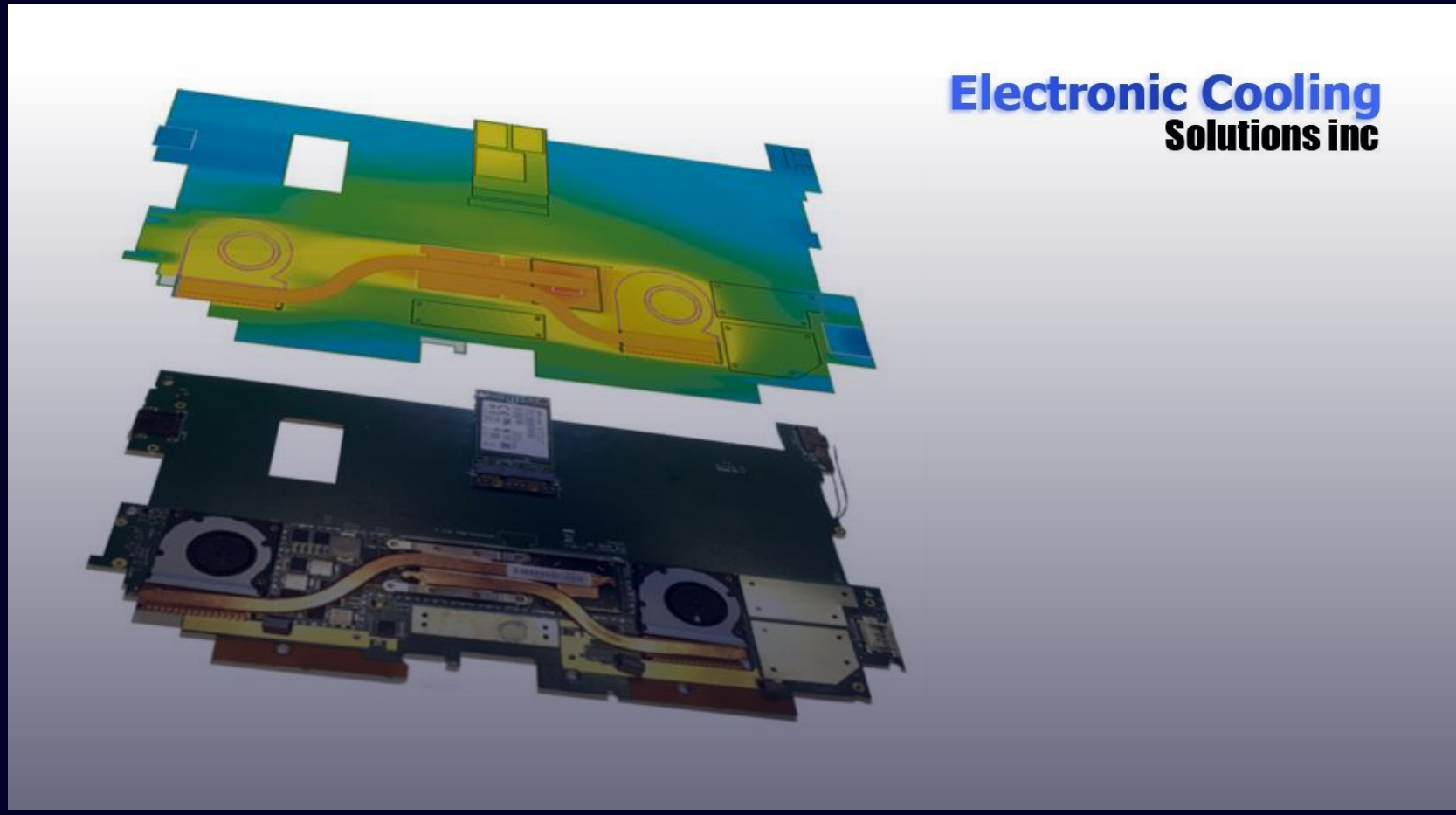
Go faster

SMB

"

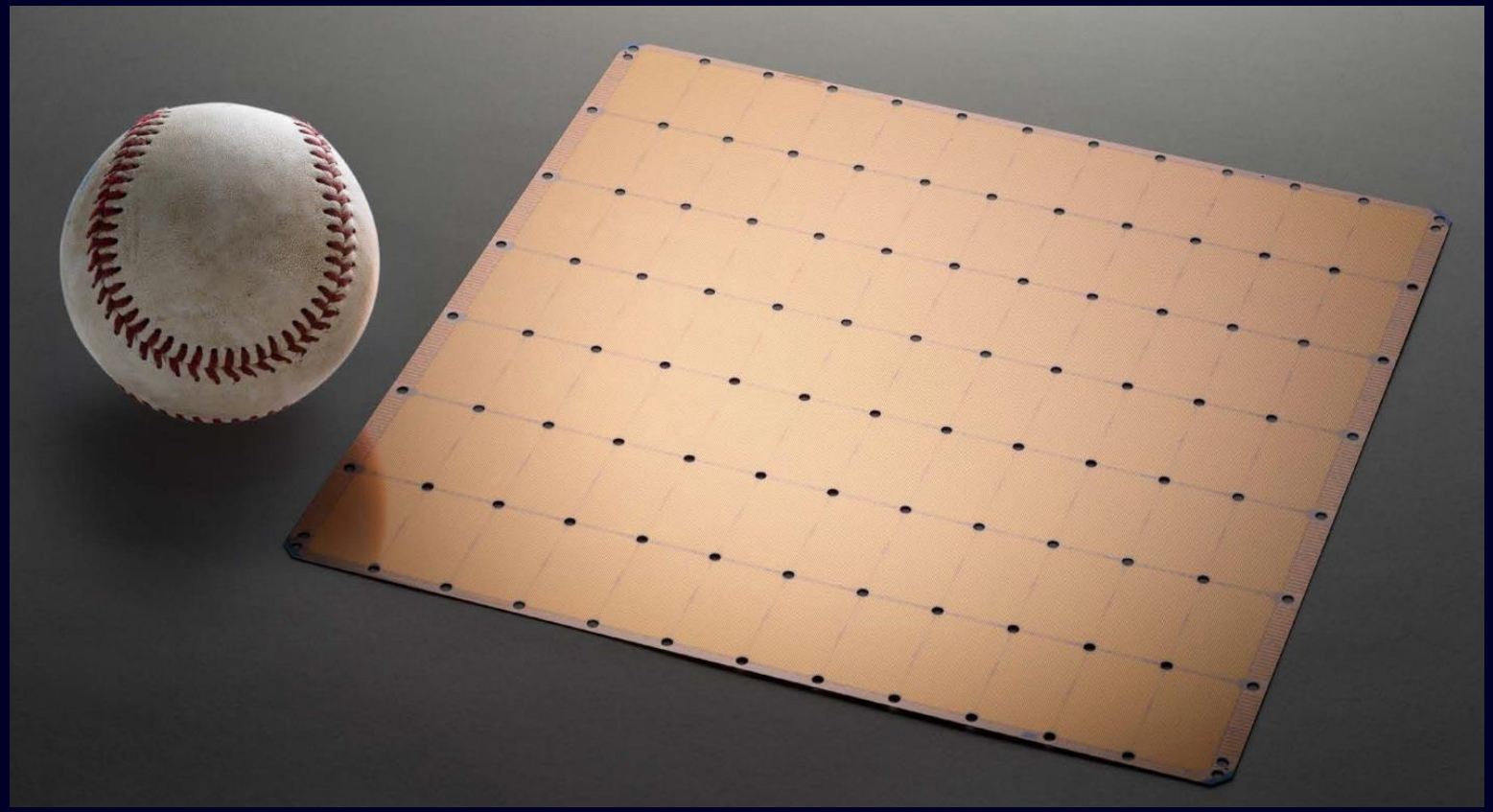
Electronics design is schedule constrained. Simcenter tools are extremely valuable because they shorten the design process significantly.

Bill Maltz
CEO
Electronic Cooling Solutions Inc.



SIEMENS

Model the complexity



Cerebras partnered with Electronic Cooling Systems (ECS) to develop the liquid cooling solution.

Cerebras Wafer-Scale Engine has 400,000 AI optimized cores, and dissipates 17.6kW. Max. allowable temperature variation limit is 7ºC.

<6.2ºC

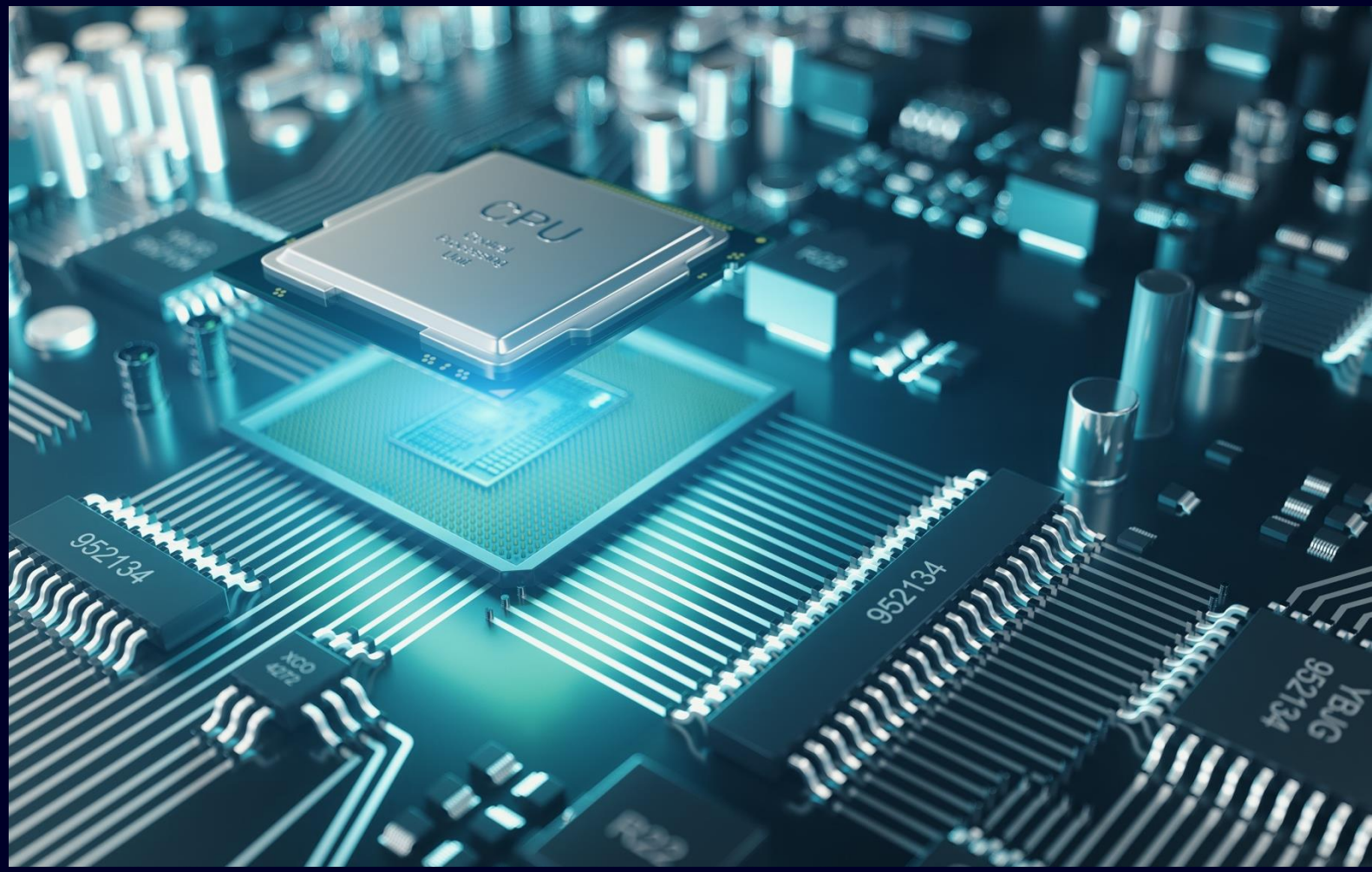
Temperature variation across the whole wafer, and <5.0ºC variation across each die achieved by ECS with Simcenter.

Explore the possibilities

"

Embeddable BCI-ROM is a great way to share our thermal models with our customers. It has several key features: easy generation, confidentiality, low error rate, and suitability for steady-state and transient applications.

Jimmy Lin, Technical Manager, MediaTek Inc



SIEMENS

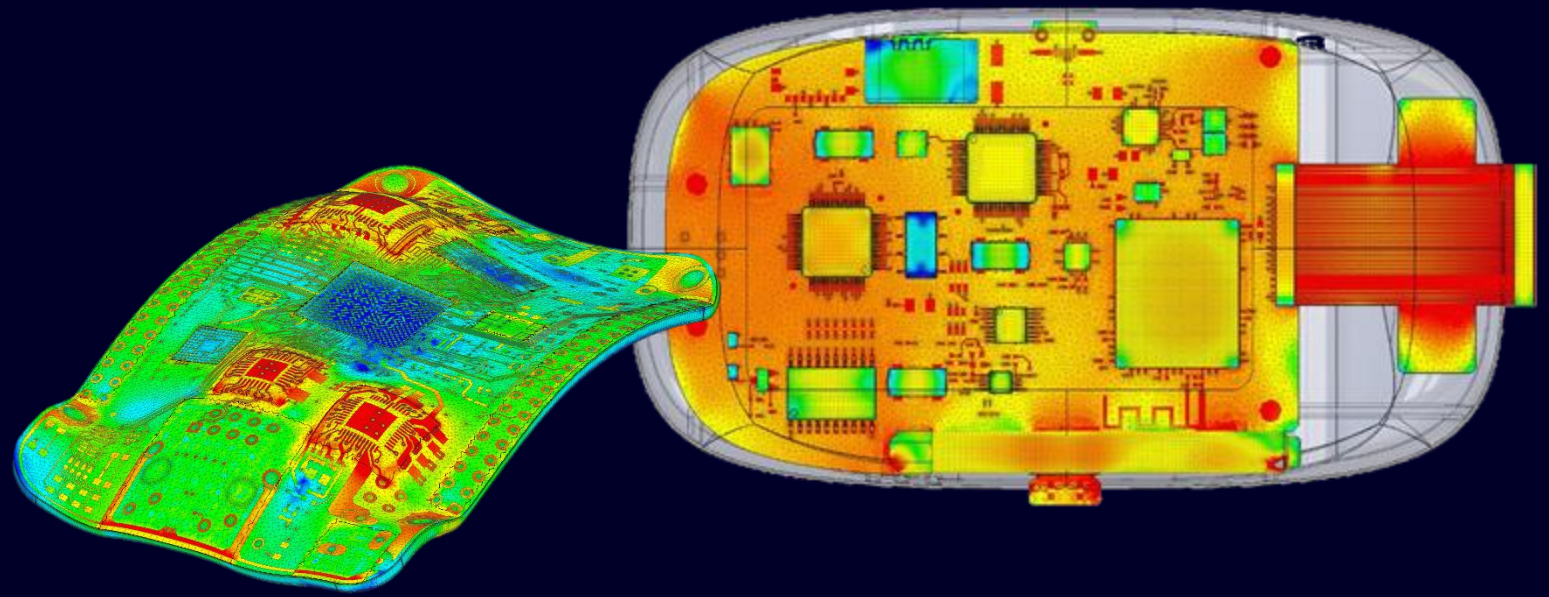
Explore thermal, thermomechanical, shock and vibration effects within a single toolset

Challenge

- PCB designs are extremely complex, often forcing simplification prior to CAE simulation
- Simulation of simplified designs risks missing key aspects of the performance

Solution

Simcenter's Smart PCB™ technology accurately captures thermal, thermomechanical and structural performance of PCBs in a highly-efficient manner.



SIEMENS

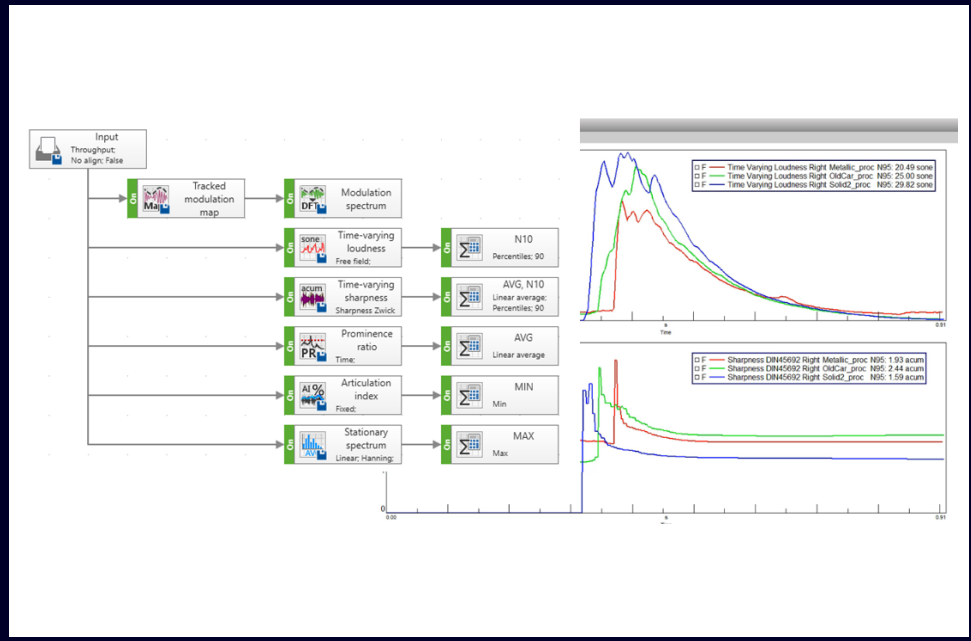
How to optimize the sound quality of electronic products based on my customers needs

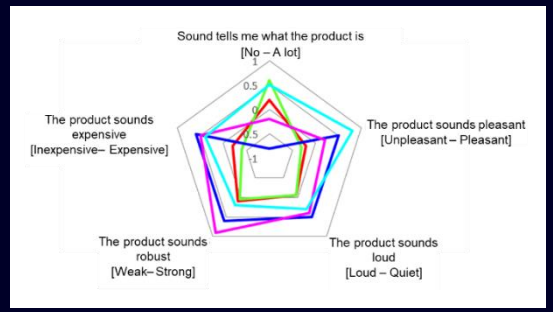
Challenge

- How to quantify annoying sounds to the users
- How to incorporate user feedback statistically into the sound evaluation of my electronics
- How to correlate objective and subjective appreciation of electronics noise

Solution

Correlated sound quality metrics and jury testing



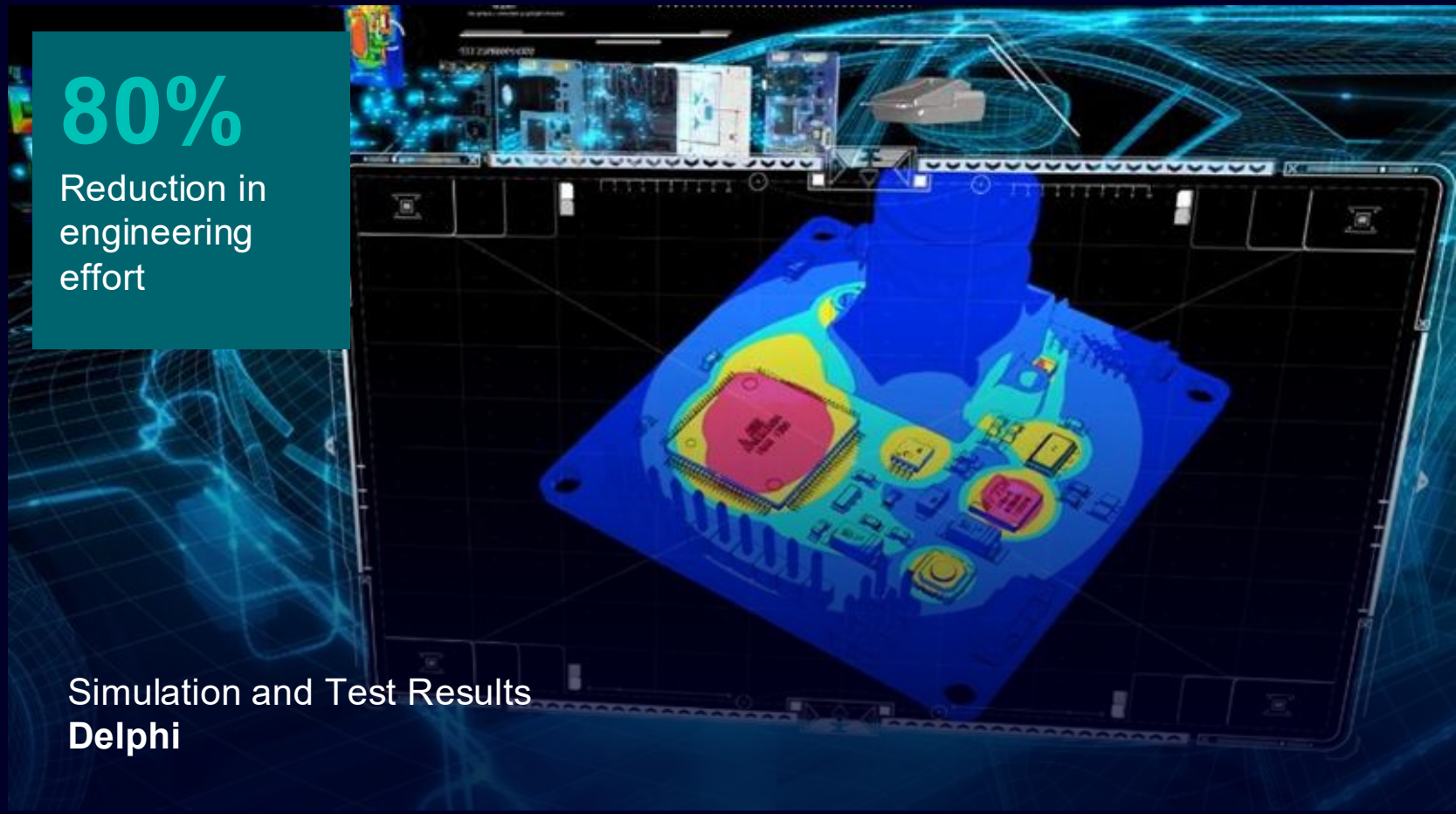


SIEMENS

Go faster

"Accurate simulation can be accomplished quickly with a few mouse clicks compared to complex processes with other tools.

Aptiv
Delphi



Simulation and Test Results
Delphi

SIEMENS

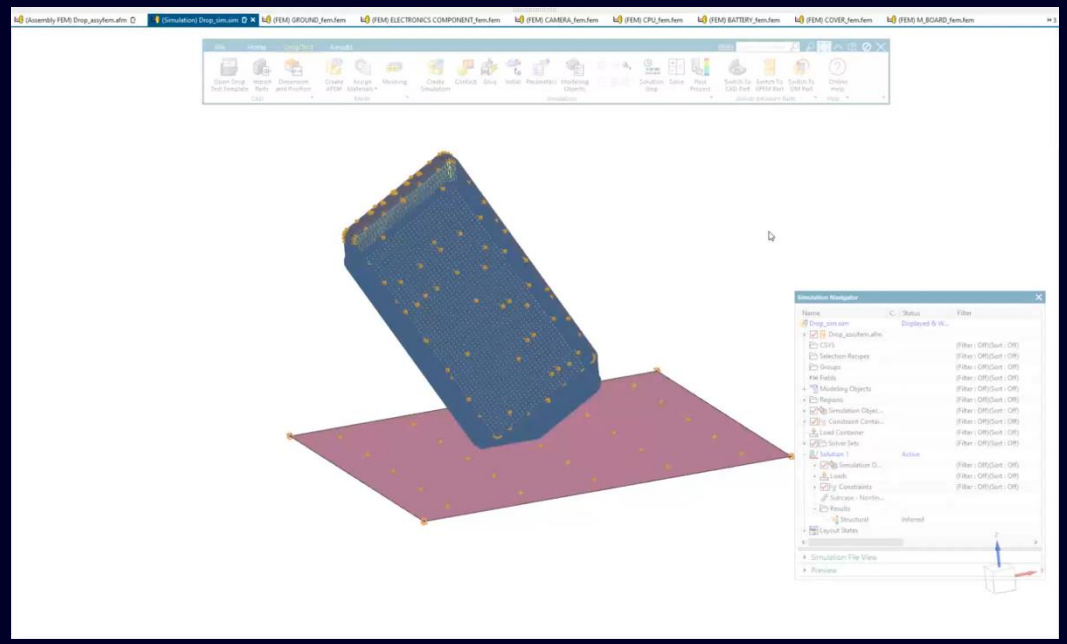
Impact analysis ensures structural integrity of electronics products

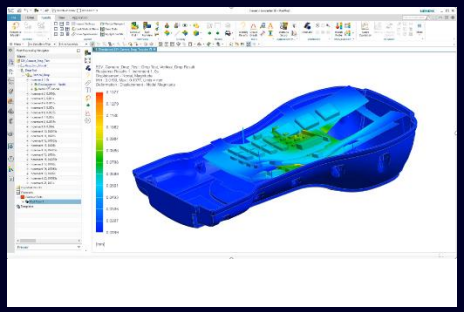
Challenge

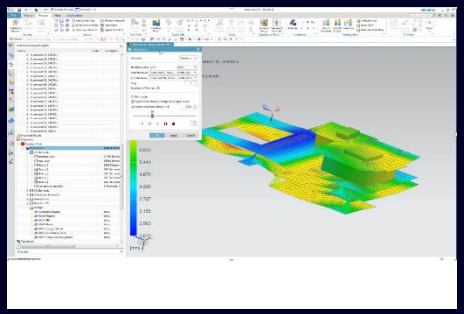
- Impacts (or drops) affect the structural integrity of electronics, in particular hand-held devices such as smartphones and tablets
- Approximately 22% of all electronic failures are due to vibration of shock

Solution

Mechanical simulation to resolve the impact on the electronic device and PCB board in terms of stress and displacement







SIEMENS

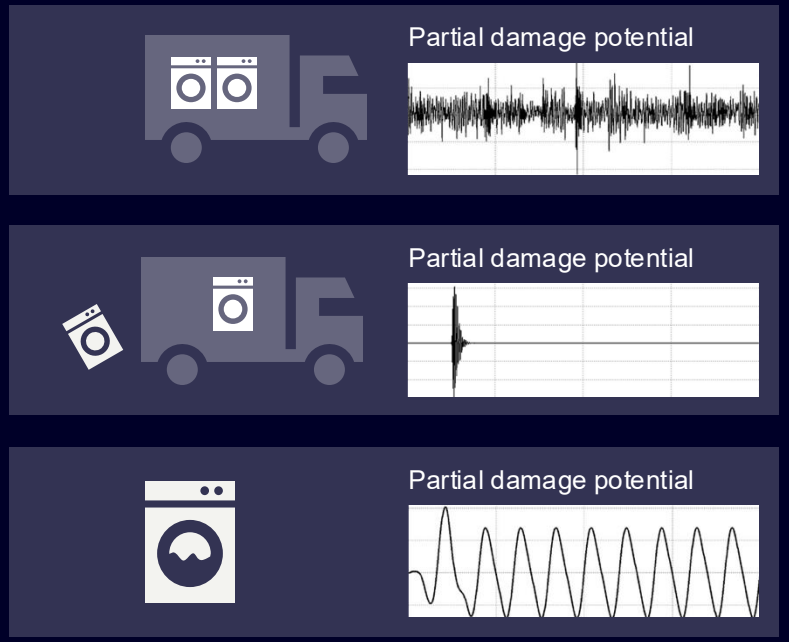
Avoid real-life vibration damage to electronic components through mission synthesis

Challenge

- Lack of realism when using industry standards for vibration qualification testing
- Product failures and recalls due to underestimation of real-life vibrations
- Product over dimensioning due to overestimation of real-life vibrations

Solution

Simcenter vibration qualification testing with mission synthesis approach delivers accelerated and realistic shaker test profiles.



SIEMENS

Comprehensive battery modeling workflow
Design and validation of microstructure, cells, battery packs and systems

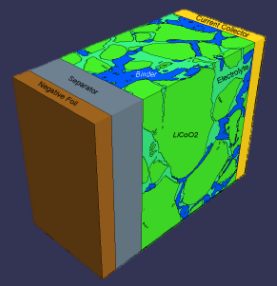
Challenge

- Li-ion batteries are pushing physicochemical limits
- Competing performance, reliability and sustainability requirements
- Auxiliary systems are needed for thermal management and control
- Overall cost and weight

Solution

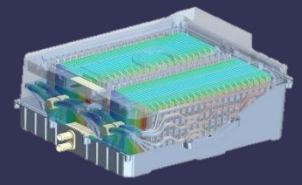
- Simcenter provides realistic models covering all aspects of cell design: Electrochemistry, flow and thermal models at cell, pack and system level
- Dedicated and connected workflows provide a continuous digital twin of the design and performance
- Exploration of all aspects of the design's performance

Electrochemistry

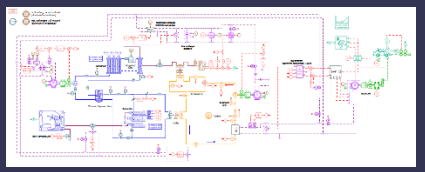


Cell

Battery Pack



System Integration



SIEMENS

TEŞEKKÜRLER

CDT TECH DAY