

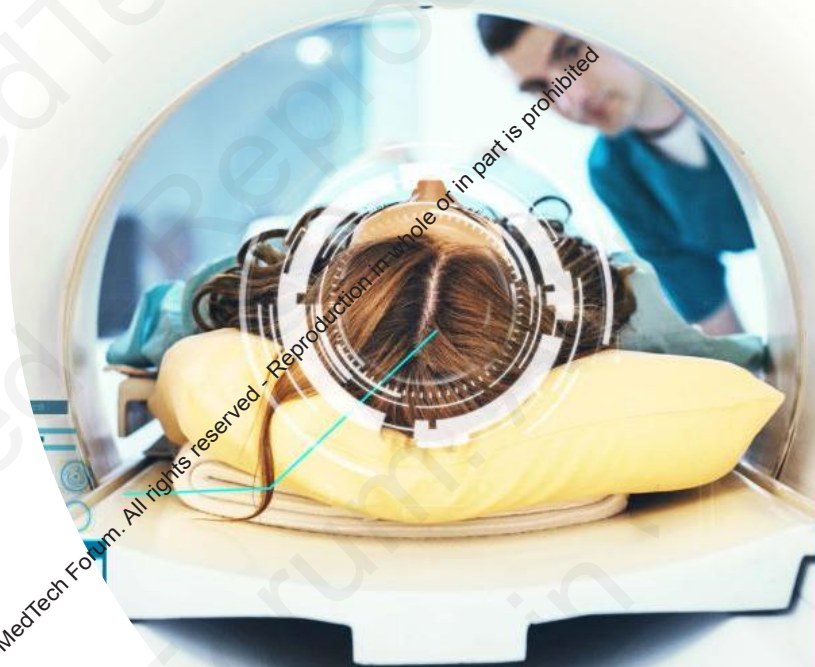


3DEXPERIENCE®

RIGHT FIRST TIME

DELIVERING COMPLEX PRODUCTS IN A COMPLEX WORLD - SUCCESSFULLY

DS DASSAULT
SYSTEMES | The 3DEXPERIENCE® Company





DASSAULT SYSTEMES - ENABLING 'VIRTUAL TWINS' SINCE 1981



a Purpose-Driven Company	Long-term Driven	290,000 Customers	12,260 Partners
Combining Art, Science & Technology for a more sustainable world	<ul style="list-style-type: none">• Revenue: €4,5Bln• 20,000 passionate people	<ul style="list-style-type: none">• 11 industries in 140 Countries• 26 million users	<ul style="list-style-type: none">• Software, Technology & Architecture• Consulting & System Integrators• Content & Online Services• Education & Research

"SOFTWARE IS EATING THE WORLD"

Can we do what was done for Consumers for Product Development?



Evolution of the Desk

LIFE SCIENCES

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OUR REACH

Our footprint gives us a unique cross-domain advantage

8,000+

Active customers

All top 20

BioPharmas & MedTech

All top 10 CROs

are customers

Active partnerships with
FDA & IMI

50%+

of drugs & medical devices
designed with our solutions

50%+

new clinical trials
supported by our solutions

25,000+

Clinical trials

45B

Clinical data points

7M+

patients

45,000+

physicians

22,000+

Hospital facilities

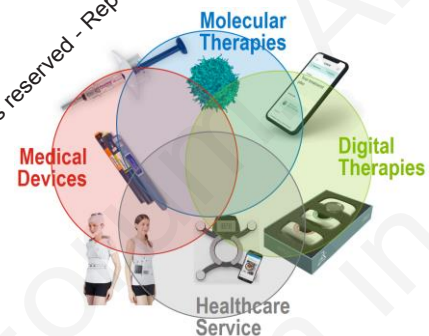
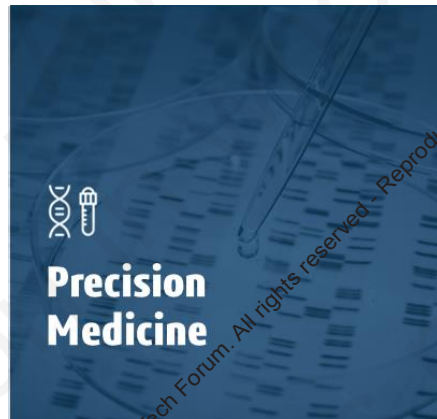
1,000+

Direct hospital connections

500M

Images processed annually

THE CHANGING NATURE OF THERAPEUTIC INNOVATION



OUR BELIEF



**Virtual worlds extend and
improve the
Real world**

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MEDTECH DEVELOPMENT & ENGINEERING

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How Can I use Modeling and Simulation to Generate Defensible Evidence in Days instead of Years?



WHY DIGITAL?



Multifactorial Complex Diseases



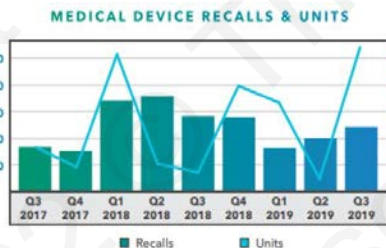
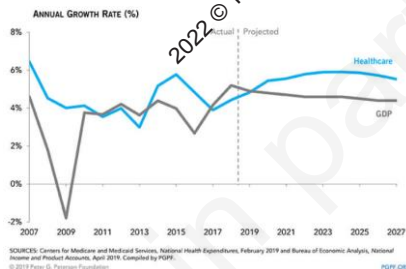
Regulatory Pressure



Intense Competition
New players



Patient
Autonomy



Stericycle
Expert Solutions



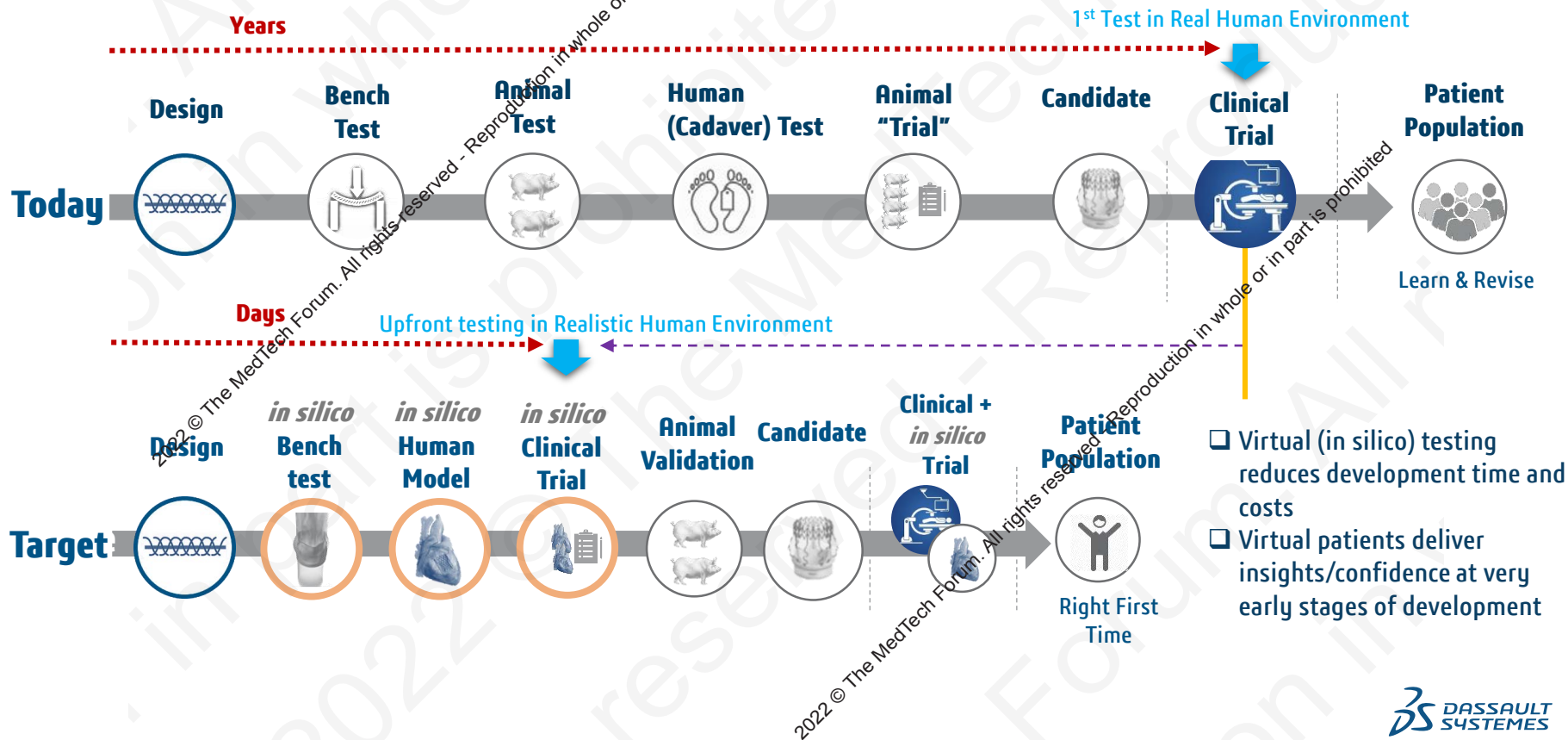
MODEX



BIO SERENITY
Smart Healthcare Solutions

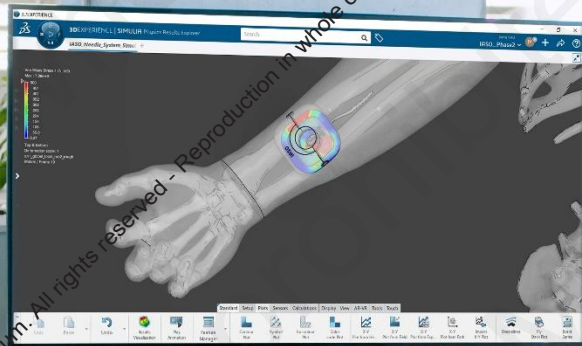
DASSAULT
SYSTEMES

HOW CAN MODELING AND SIMULATION HELP?





3DEXPERIENCE

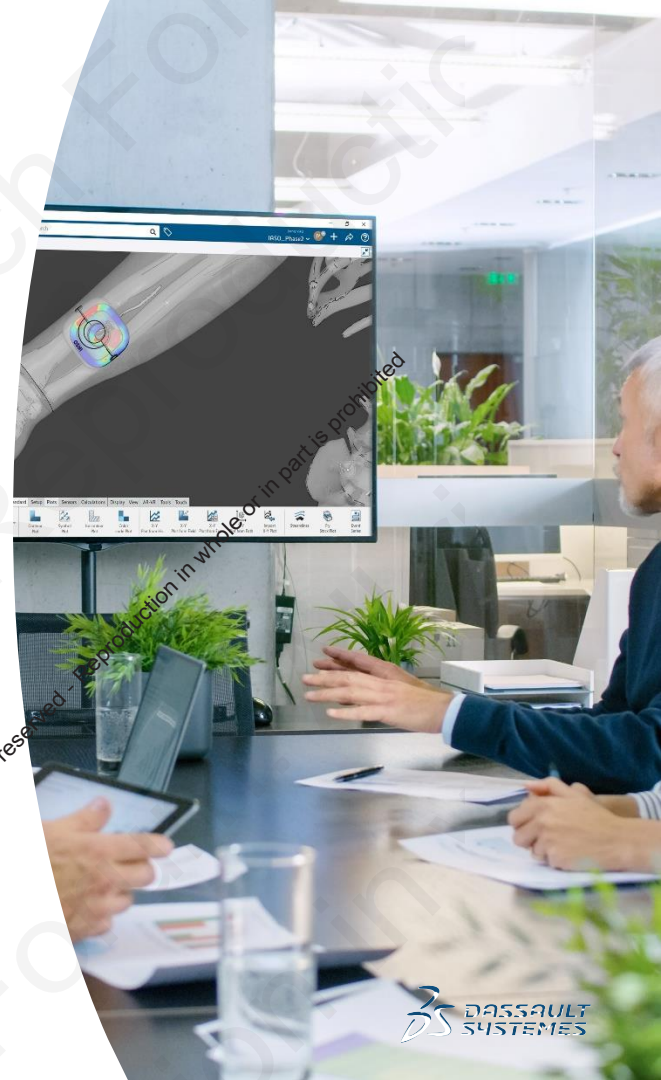


ENGINEERED TO CURE

DEVELOP SAFE AND EFFECTIVE MEDICAL DEVICES WITH
COLLABORATIVE DESIGN AND SIMULATION

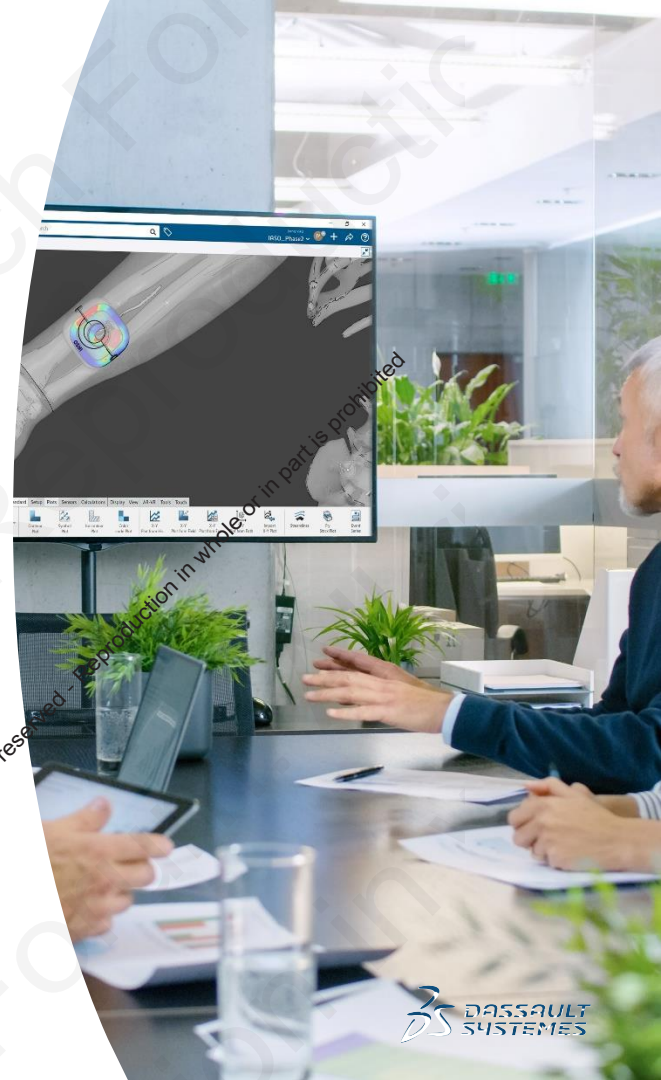
WITH ENGINEERED TO CURE

- **Reduce Device Development Time and Cost** by systematically adopting Virtual Testing in place of Physical Testing
- **Shorten Time from Concept through Final Design** through Collaborative Modeling and Simulation (MODSIM)
- **Expand Innovation Bandwidth** using Process Automation and Democratization to empower experts and non-experts alike (MODSIM)
- **Improve Device Safety and Effectiveness** by assessing device performance with realistic validated Virtual Human models
- **Meet all Performance, Quality, and Compliance Requirements** using a Model-Based Systems Engineering approach
- **Reduce Risk of Expensive Late-Stage Design Modification** by experiencing the device in its context of use with Human Factors Design
- **Optimize Component Sourcing and Streamline New Part Introduction** using Standard Component Management



WITH ENGINEERED TO CURE

- **Reduce Device Development Time and Cost** by **systematically adopting Virtual Testing** in place of Physical Testing
- **Shorten Time from Concept through Final Design** through **Collaborative Ways of Working**.
- **Expand Innovation Bandwidth** using **Process Automation and Democratization** to empower experts and non-experts alike (MODSIM)
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- **Optimize Component Sourcing and Streamline New Part Introduction** using **Standard Components** Management



DESIGN & ENGINEERING ON THE 3DEXPERIENCE PLATFORM

COMPREHENSIVE MULTIPHYSICS- MULTISCALE FRAMEWORK

Assess real-world device and patient behavior at all levels of abstraction

Enhanced Device Reliability and Safety

FULLY INTEGRATED MODELING AND SIMULATION (MODSIM)

Enable seamless collaboration between designers and analysts

Reduced Product Development Time and Cost

END-TO-END REQUIREMENTS MANAGEMENT & TRACEABILITY



Improve Product Performance and Audit-Ready Traceability

Greater Quality and Compliance

SINGLE BUSINESS AND ENGINEERING PLATFORM

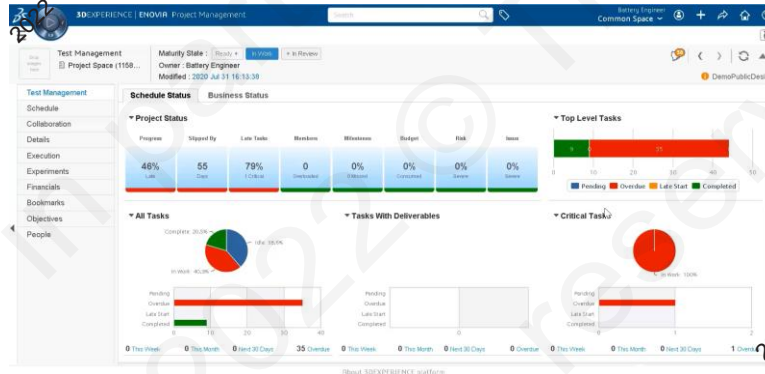


Connect all stakeholders across the enterprise with a single source of truth

Increased Innovation Bandwidth

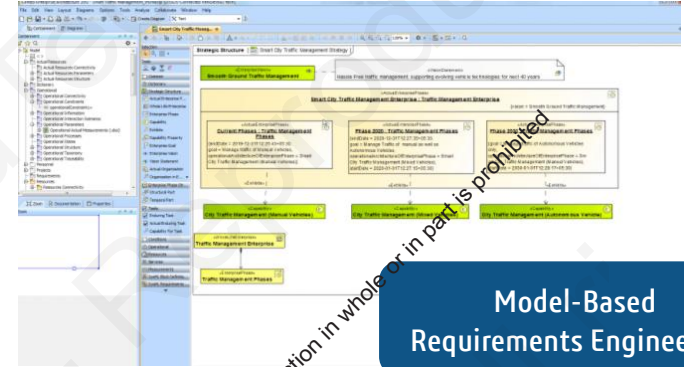
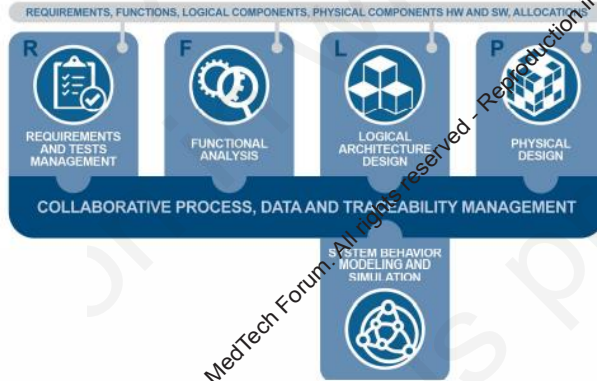
SINGLE BUSINESS AND ENGINEERING PLATFORM

- ❑ Personalized environment connecting all stakeholders with a single source of information early in the innovation process
- ❑ Intuitive apps for social collaboration, 3D visualization, and data-driven decision-making accessible anytime from anywhere



END-TO-END REQUIREMENTS MANAGEMENT & TRACEABILITY

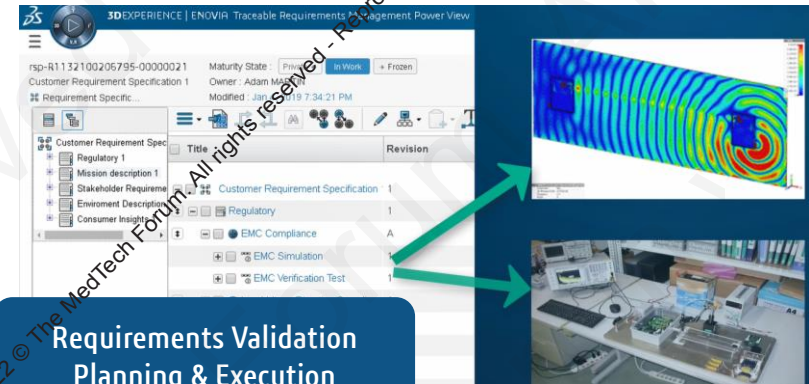
- Customer needs clearly linked to medical device requirements, functions, systems, and validation strategies
- Best-in-class Model-Based Systems Engineering tools to ensure device performance, quality, compliance



Model-Based Requirements Engineering



Traceable Requirements Management



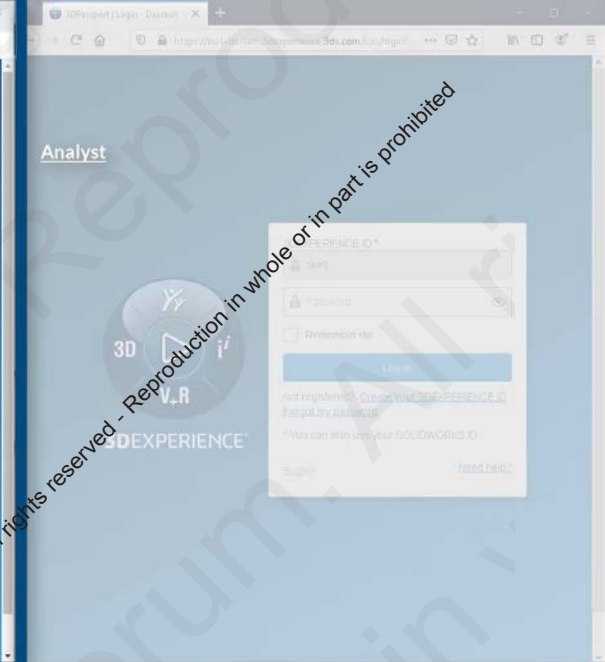
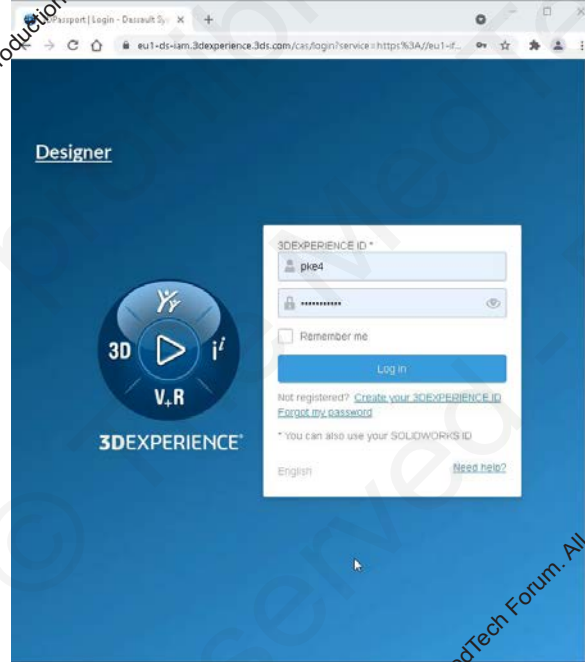
Requirements Validation Planning & Execution

FULLY INTEGRATED MODELING AND SIMULATION

- ❑ Model-based collaboration between design engineers and simulation analysts to reduce design cycle time
- ❑ Simulation-driven design optimization to reduce likelihood of expensive late-stage design modifications



Typical Insulin Pen
Internal Details



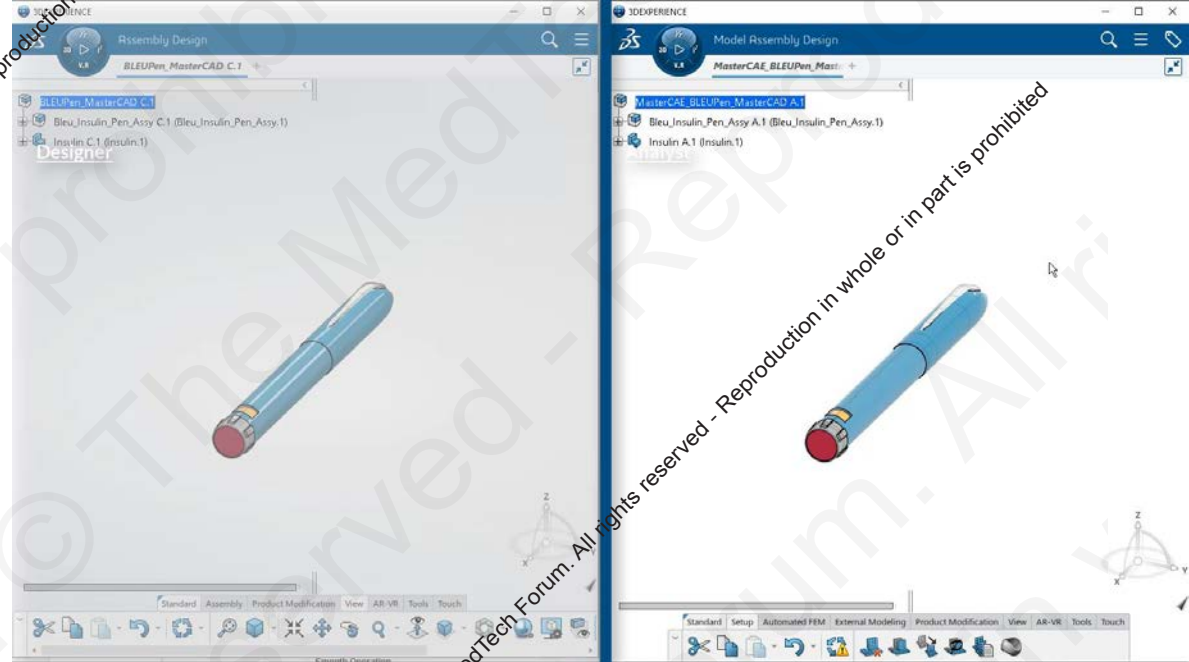
Designer and Analyst use Model-based
Collaboration to Optimize Device Design

FULLY INTEGRATED MODELING AND SIMULATION

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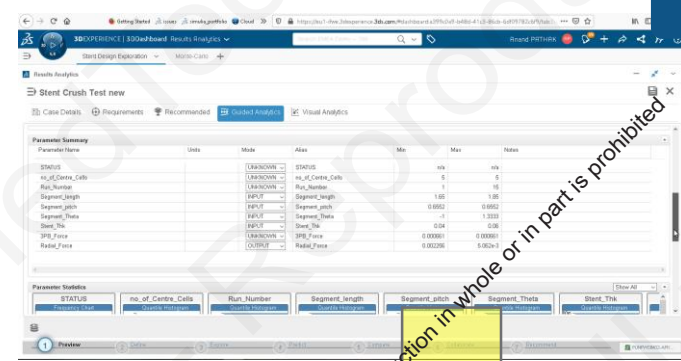
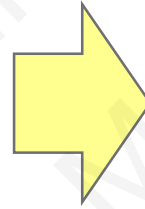
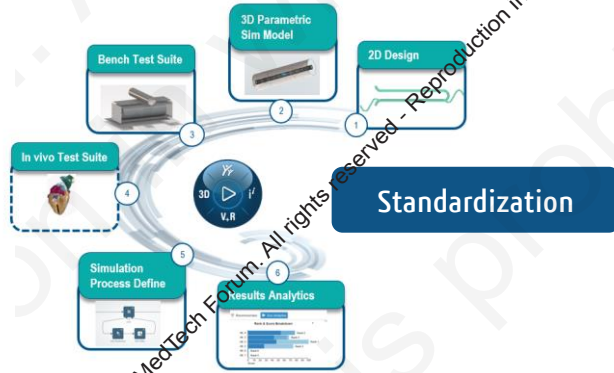
Typical Insulin Pen
Internal Details



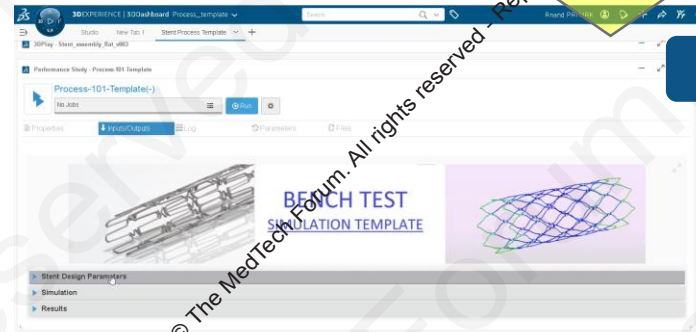
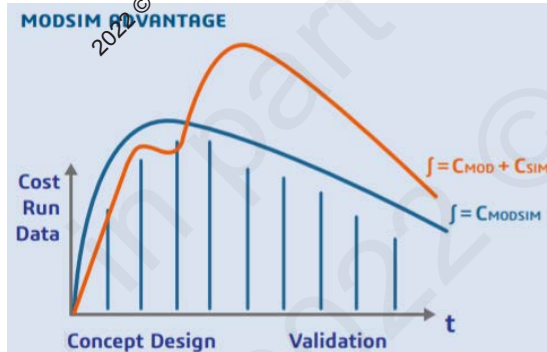
Designer and Analyst use Model-based
Collaboration to Optimize Device Design

FULLY INTEGRATED MODELING AND SIMULATION

- ❑ Automatically and efficiently explore design trade-offs to converge on the optimal and most robust design
- ❑ Easily compose custom processes integrating all modeling and simulation processes, tools, and data



Automation

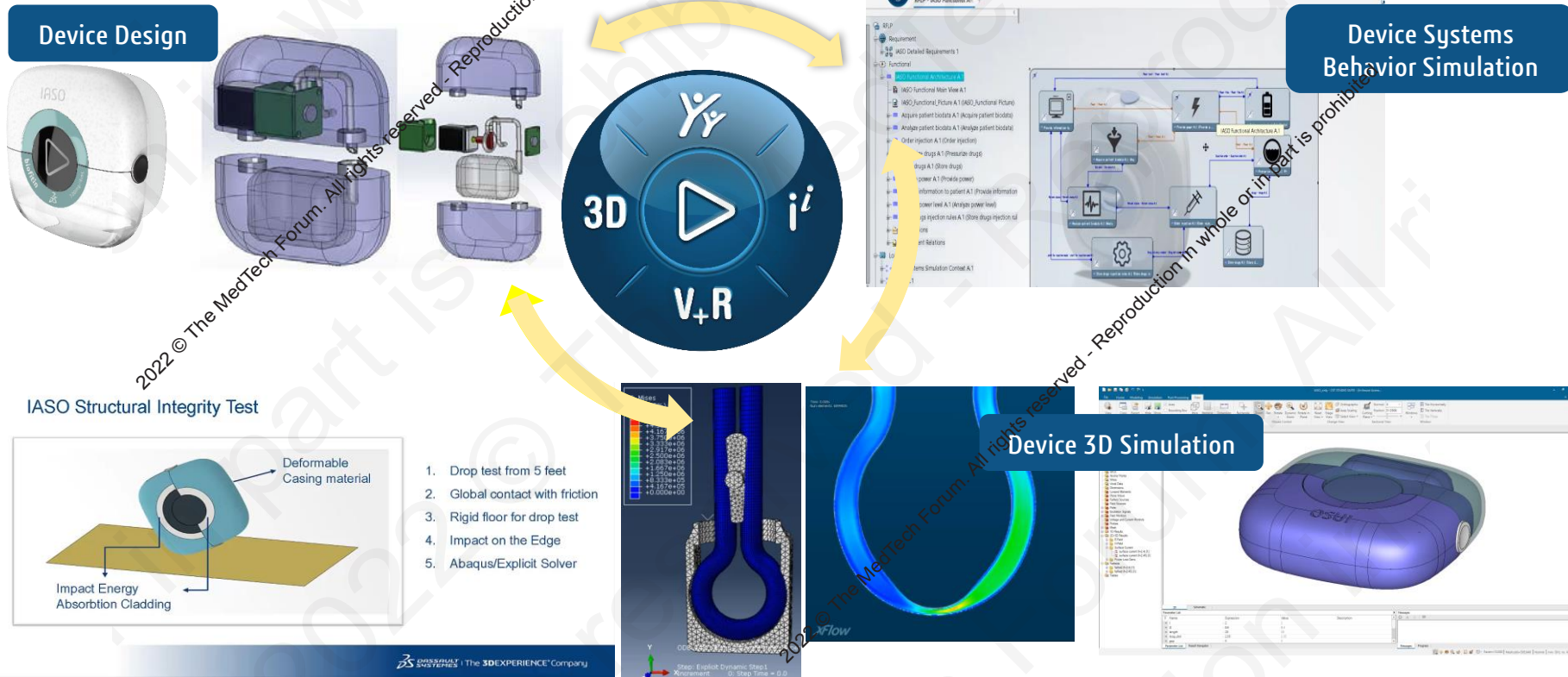


Democratization

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COMPREHENSIVE MULTIPHYSICS-MULTISCALE FRAMEWORK

- ❑ Multiphysics simulation to model behavior of medical devices under real world operating conditions
- ❑ Full compatibility between device design (CAD), 3D simulation (CAE), and systems behavior simulation



BREADTH OF CAPABILITIES

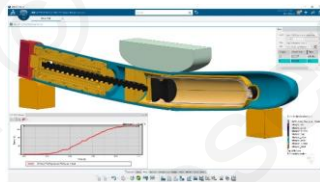
REQUIREMENTS ENGINEERING

Leverage a systems approach to medical device requirements for efficient and compliant design and development including automatic completion of the *Design History File* and *Device Master Record*



MECHANICAL ENGINEERING

Virtually design and validate device mechanical performance using regulatory grade models that deliver defensible results, thereby reducing the need for physical testing and the cost and time of new product development



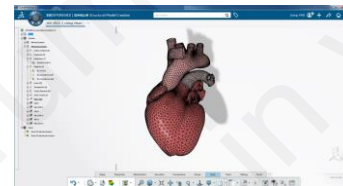
ELECTROMAGNETICS PERFORMANCE

Improve the electromagnetic reliability, safety, and certification of medical devices using proven simulation techniques and reduce the need for physical testing and the cost and time of new product development



VIRTUAL HUMAN CLINIC

Reduce reliance on animal and clinical testing, accelerate the regulatory approval process, and improve device performance, patient satisfaction, and treatment outcome.



PATIENT TWINS

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A NEW LEVEL OF VIRTUAL EXPERIMENTATION

Multi Discipline

Bio
Sciences

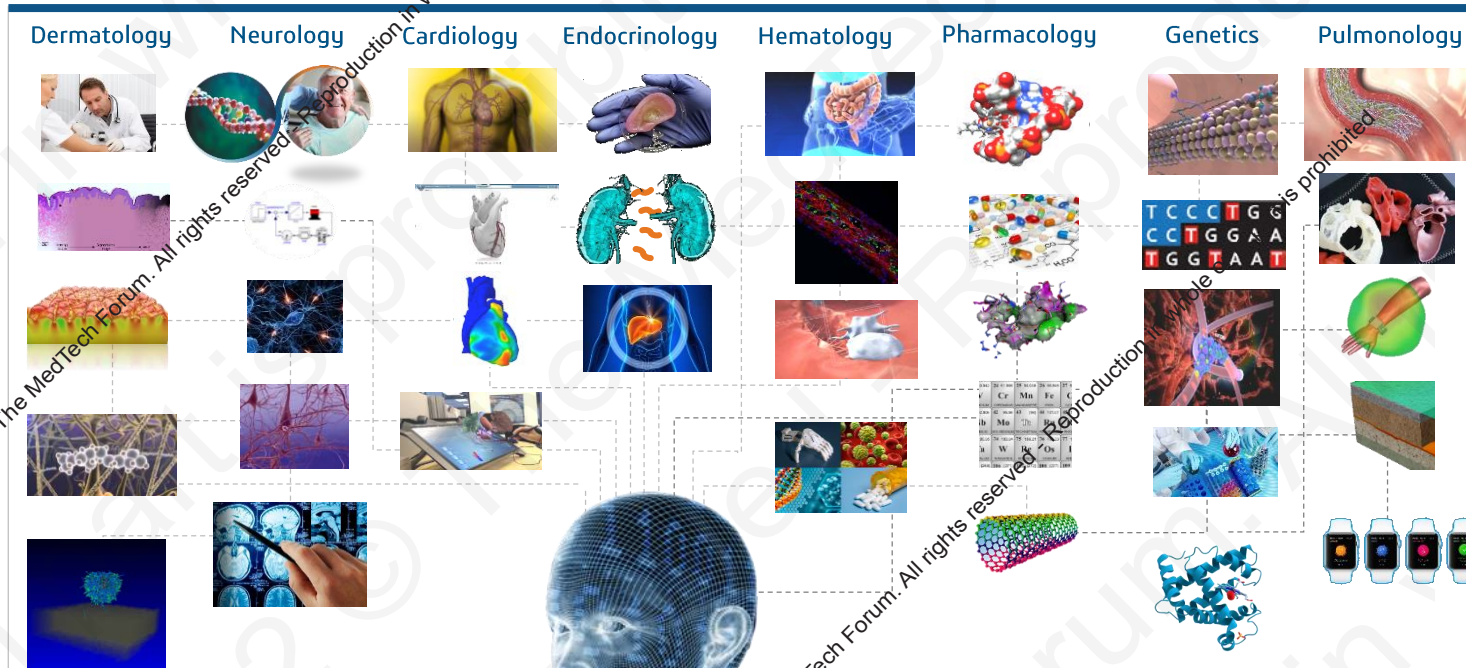
Population

Cohort

Physical
Macroscale
Continuum

Physical
Microscale
Non-Continuum

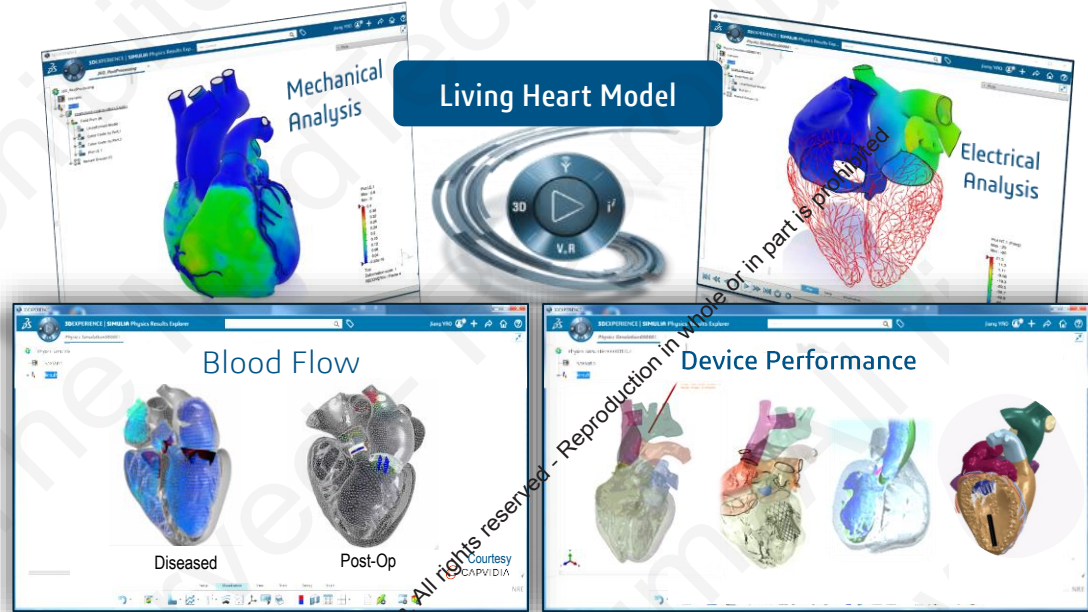
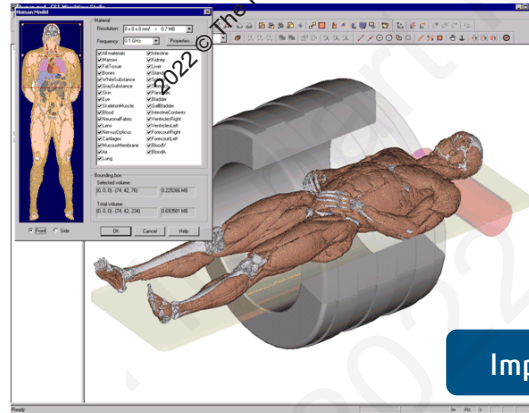
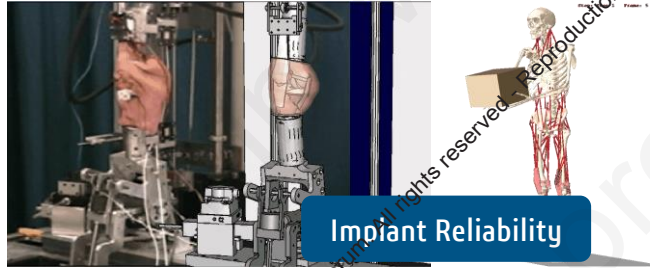
Multiscale



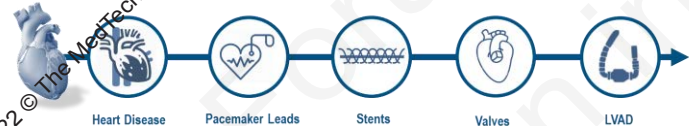
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COMPREHENSIVE MULTIPHYSICS-MULTISCALE FRAMEWORK

- Virtual Human Modeling to assess device reliability and safety using realistic human models
- Living Heart Model to reduce reliance on clinical tests using validated cardiac models



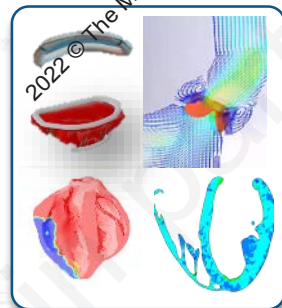
PROVEN WORKFLOWS



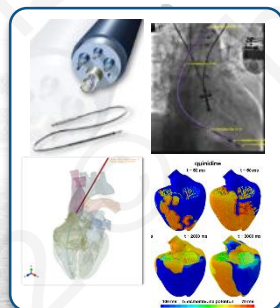
LIVING HEART: VIRTUAL DESIGN & TESTING OF CARDIOVASCULAR TREATMENTS



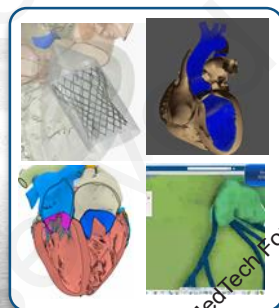
Heart Attack & Stroke



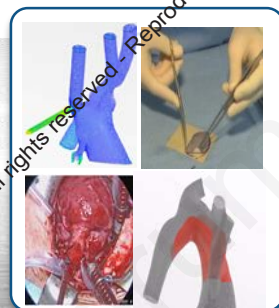
Abnormal Heart Rhythm



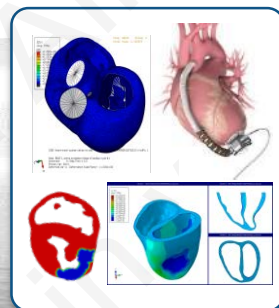
Stents, Valves, Clips



Congenital Heart Disease



Heart Failure & LVAD



VIRTUAL TWIN OF HUMANS: LIVING BRAIN

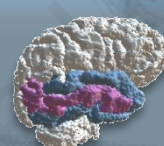
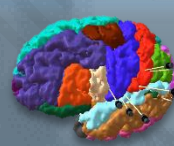
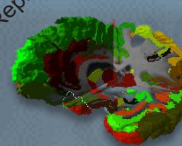
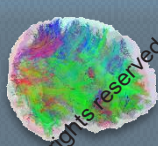
Cortical surface
from T1 imaging

Tractography
from
Diffusion imaging

Anatomic
Brain Atlas

S-EEG
Implantation

Epileptogenic
Zone
Estimation



Segmentation

Fiber
Tracking

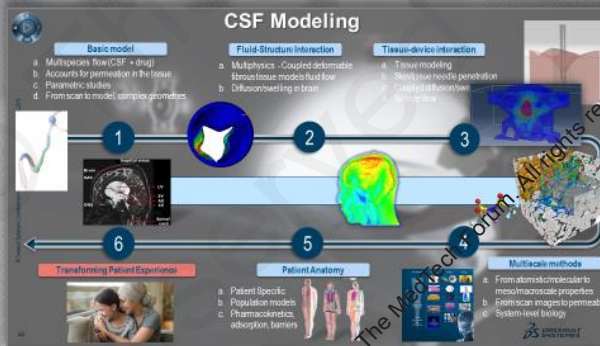
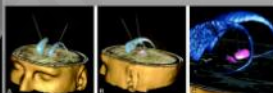
VEP Parcellation

Coregistration

Data
Fitting



Deep Brain Stimulation



Case Study

Progression of Neurodegenerative Disease

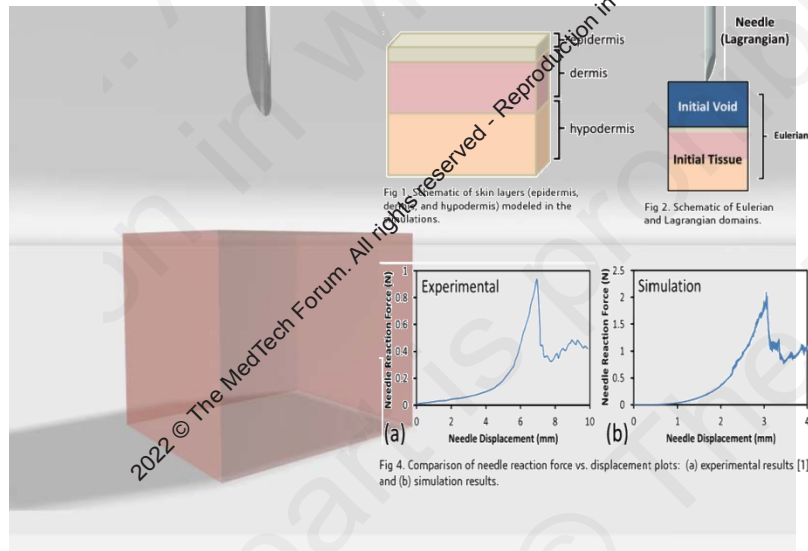
CONTRIBUTORS:

Johannes Weickenmeier¹, Ellen Kuhl¹, and Alain Goriely¹

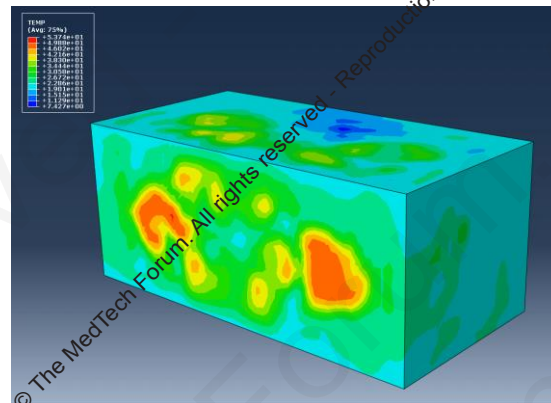
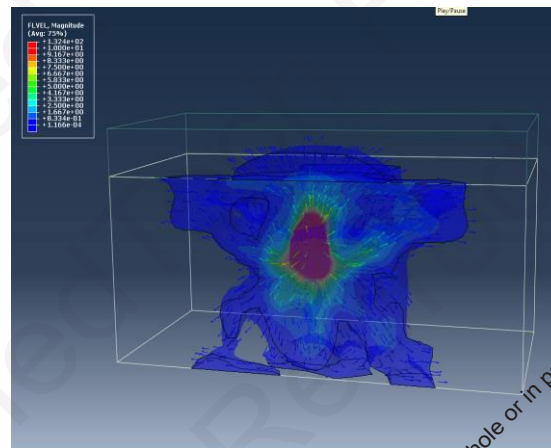
¹Stevens Institute of Technology, New Jersey, USA
²Living Matter Laboratory, Stanford University, Stanford, California, USA
³Mathematical Institute, University of Oxford, Oxford, United Kingdom



DEVICE-SKIN INTERACTION



Needle penetration in skin including tissue damage modeling



USE CASES

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TESTIMONIALS

Torben Strom Hansen
Executive Director
Novo Nordisk

"We explored a number of software codes and chose Abaqus because it was a well-integrated solution that could model the nonlinear behavior of the fine details of our assembly correctly, including the high number of interfaces in contact."



Yan Zhang
Accelerator Engineer
Mevion

"The low frequency solvers from Dassault Systèmes are critical to our design process."



Shawn Chen
Principal Engineer
Abbott

"The Living Heart Model provides a virtual environment to evaluate device-heart interaction at elevated heart rate."



Improve Device Integrity and Enhance Patient Experience



CHALLENGE

- Novo Nordisk is a leading global provider of diabetes care medications and devices. They were trying to develop insulin pens that are portable, reliable, easy to use, and consistent.
- *"We explored a number of software codes and chose Abaqus because it was a well-integrated solution that could model the nonlinear behavior of the fine details of our assembly correctly, including the high number of interfaces in contact."* - Torben Strom Hansen, Executive Director, Novo Nordisk



BENEFITS

- Accurate modeling of the material behavior of nonlinear polymers at all operating conditions
- Ability to design insulin injectors with multiple contact interfaces and snap fit locking mechanisms
- Significant reduction in cycle time by using an integrated Modeling and Simulation paradigm



SOLUTION

- Engineered To Cure Industry Solution Experience with Device Mechanical Engineering



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Improve Device Performance and Enhance Patient Safety



CHALLENGE

- Mevion Medical Systems is a leading provider of proton therapy systems for use in radiation treatment for cancer patients. The company was looking to enhance beam quality, increase stability and uptime to reduce system complexity, and increase equipment reliability, all while lowering capital and operating costs.
- *"The low frequency solvers from Dassault Systèmes are critical to our design process."* – Yan Zhang, Accelerator Engineer, Mevion



BENEFITS

- Accurate modeling of the behavior of charged particles in electrostatic and magnetostatic fields
- Ability to simulate the coupling of electromagnetic and thermal effects
- Access to full suite of SIMULIA EM simulation solutions for designing, analyzing, and optimizing EM components and systems



SOLUTION

- Engineered To Cure Industry Solution Experience with Device Electromagnetics Performance



Reduce Reliance on Expensive Clinical Testing



CHALLENGE

- Abbott is a leading global provider of medical devices, diagnostics, branded generic medicines, and nutritional products. They were trying to understand how intracardiac devices might behave under abnormal physiological conditions to improve device performance and safety.
- *"The Living Heart Model provides a virtual environment to evaluate device-heart interaction at elevated heart rate."* - Shawn Chen, Principal Engineer, Abbott



BENEFITS

- Access to a realistic model of the human heart that can be modified to represent abnormal cardiac states
- Ability to simulate the interaction between medical devices and the human heart
- Ability to rapidly explore device and human variability while reducing reliance on human testing



SOLUTION

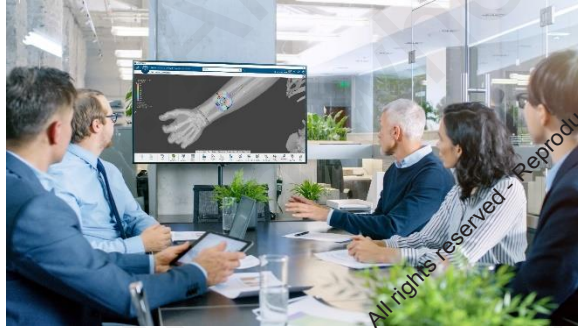
- Engineered To Cure Industry Solution Experience with Virtual Human Clinic



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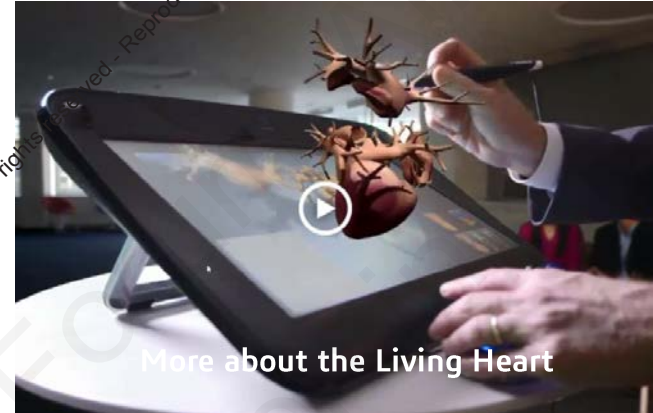
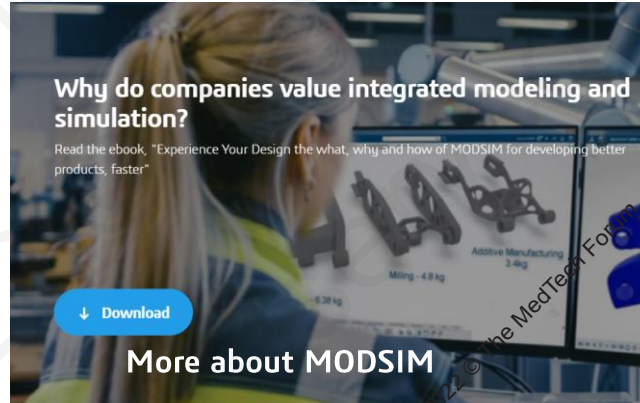
LEARN MORE



Solution Overview: Engineered To Cure



Case Study: Novo Nordisk



QUESTIONS?

THANK YOU!

BARBARA.HOLTZ@3DS.COM

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