



# MSC Apex Generative Design



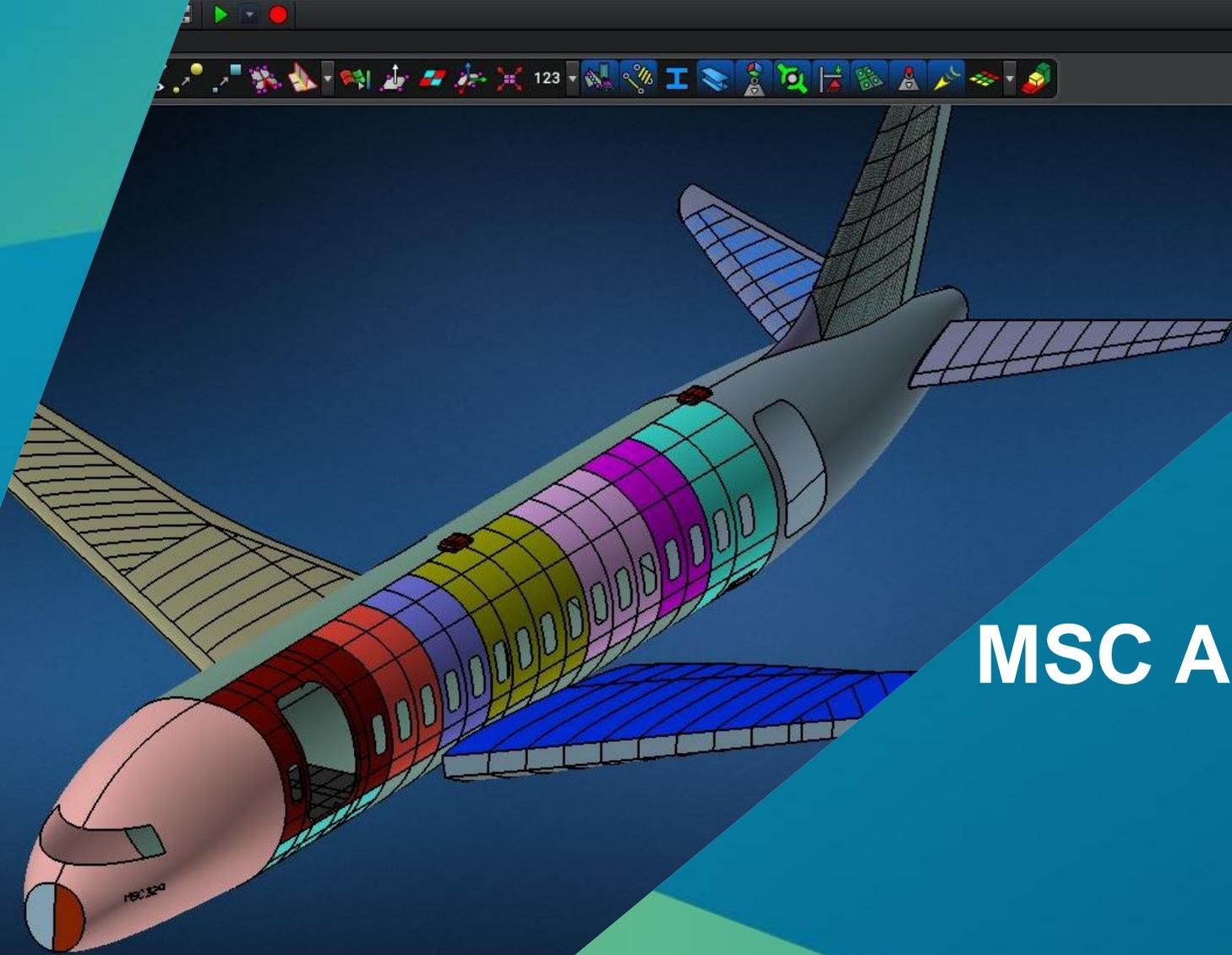
James Pura

MSC Apex Global Product Marketing Manager

May 7, 2020

# Agenda

- 1 **MSC Apex – What is it, and how is it different?**
- 2 **What is Generative Design?**
- 3 **What is MSC Apex Generative Design, and how does it fit into the Additive Workflow?**
- 4 **How has this product helped Customers Today?**
- 5 **Demonstration: End-to-End Additive Workflow**



# MSC Apex – What is it, and how is it different?



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MSC Software

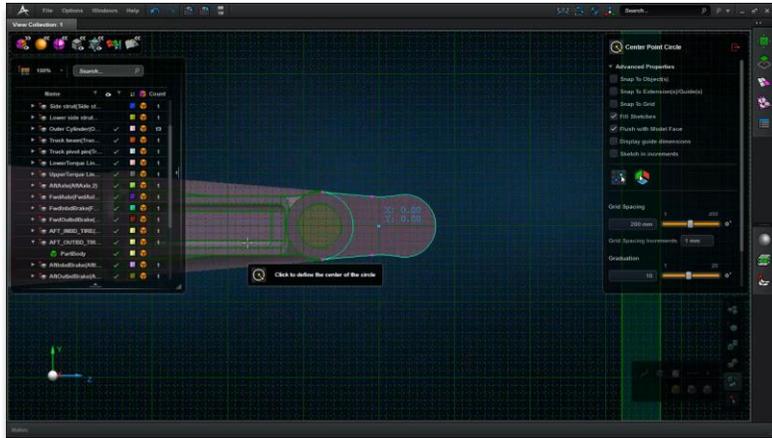
# What is MSC Apex?

MSC Apex is MSC's new CAE platform

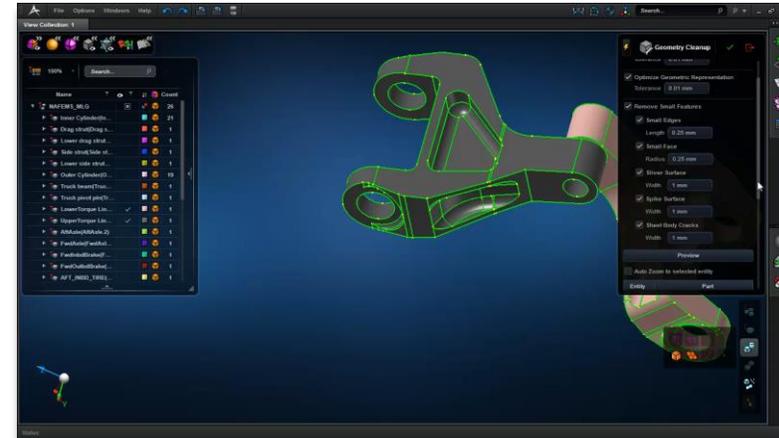
- A unique game-changing user experience, easy-to-learn, easy-to-use
- With CAE specific Direct Modeling and Meshing
- With Integrated, Incremental Solver Methods for Solver Validated Modeling
- Based on Computational Parts & Assemblies Technologies



# MSC Apex – How is it Being Used Today for **Geometry**?



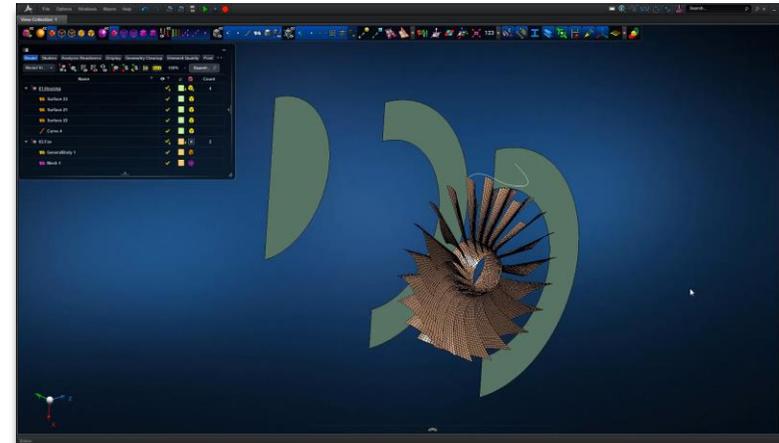
Sketching



Geometry Repair

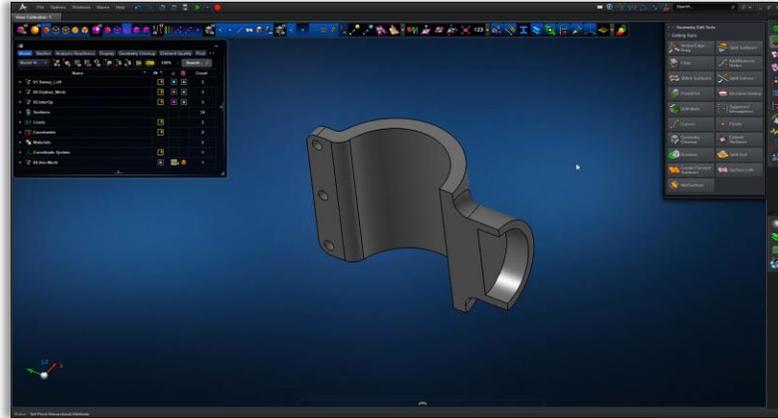


De-featuresing

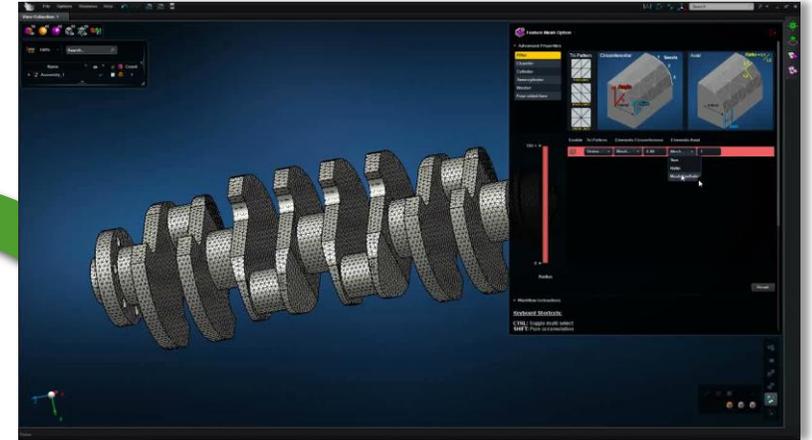


Revolve/Extrude/Sweep/Lofting

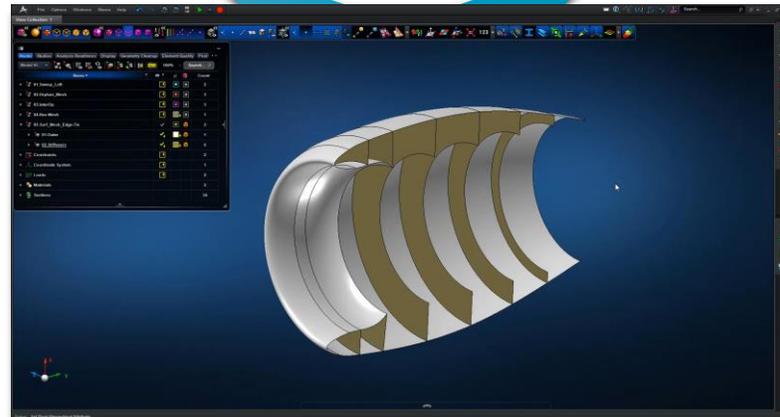
# MSC Apex – How is it Being Used Today for **Meshing**?



Accurate Hex Meshing

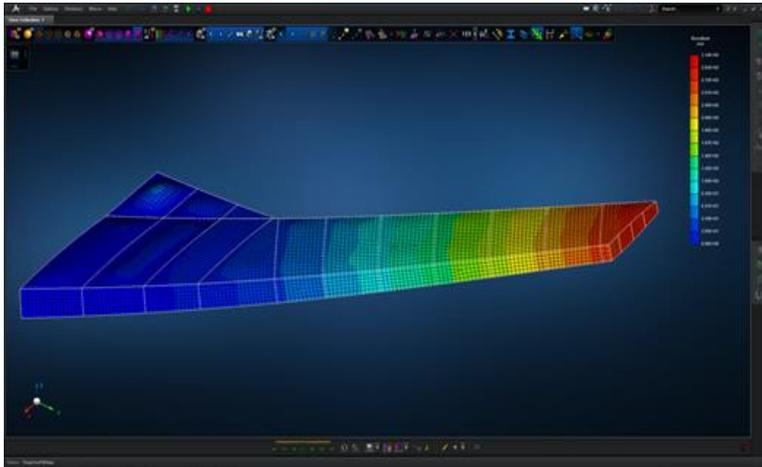


Feature-Based Meshing

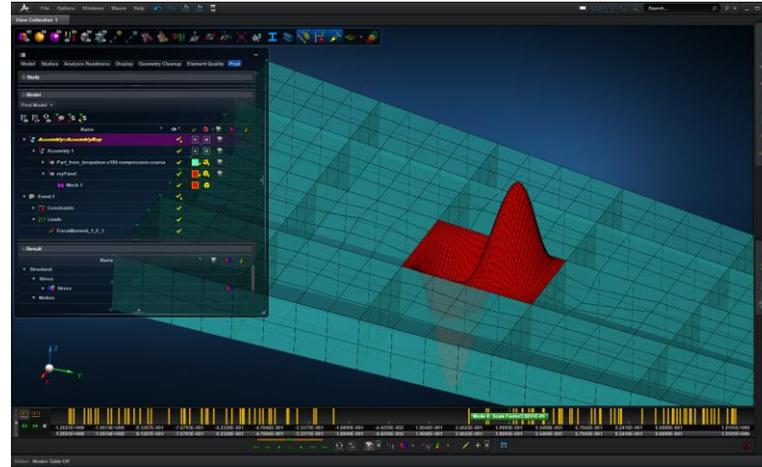


Automatic Mesh-Geometry Interactive Updates

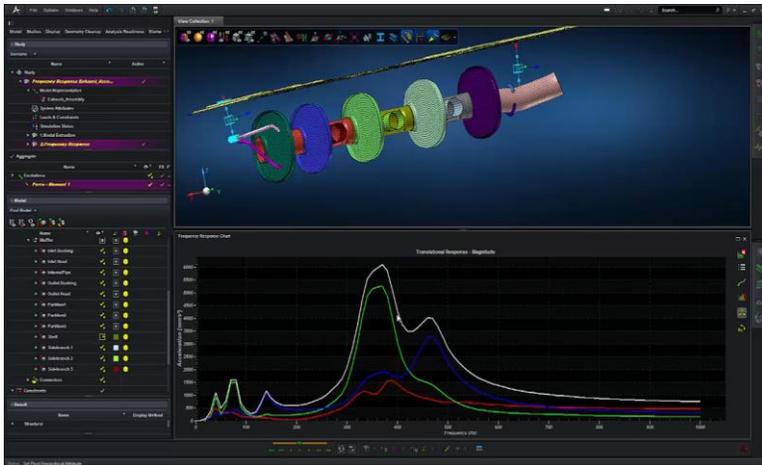
# MSC Apex – How is it Being Used Today for **Design Trade-Off Studies**?



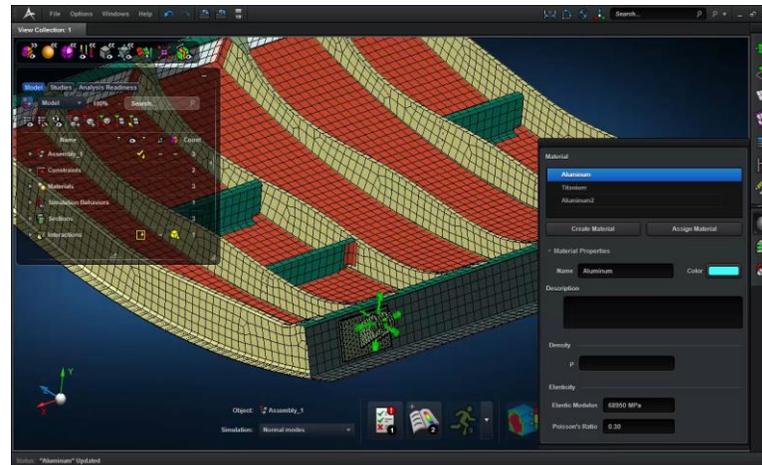
Linear Static



Linear Buckling



Frequency Response



Normal Modes

Real Time  
Result  
Exploration



Automatic  
Result  
Update



Integrated  
Solver  
Methods

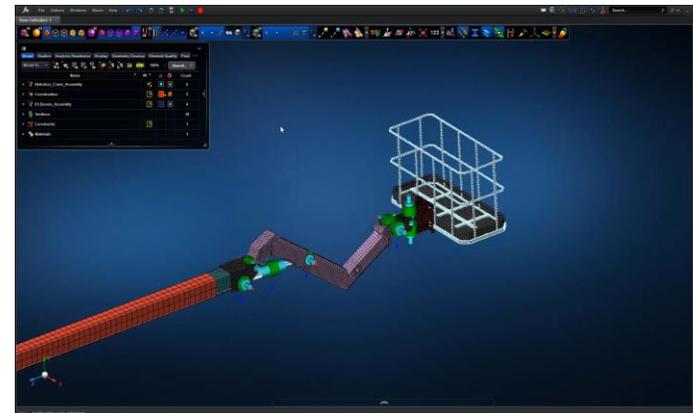
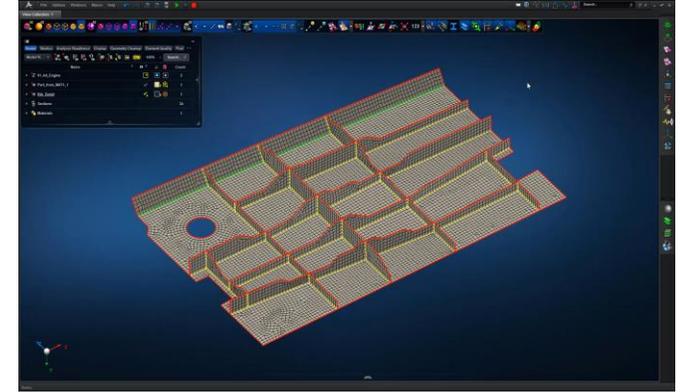
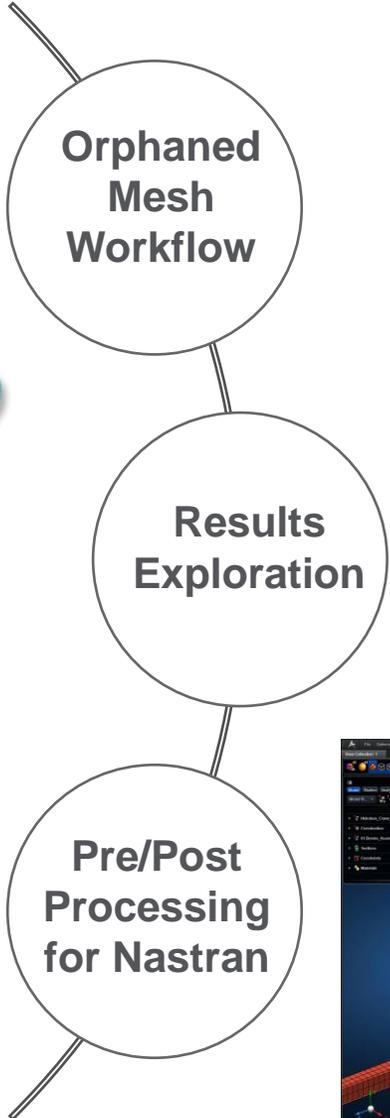
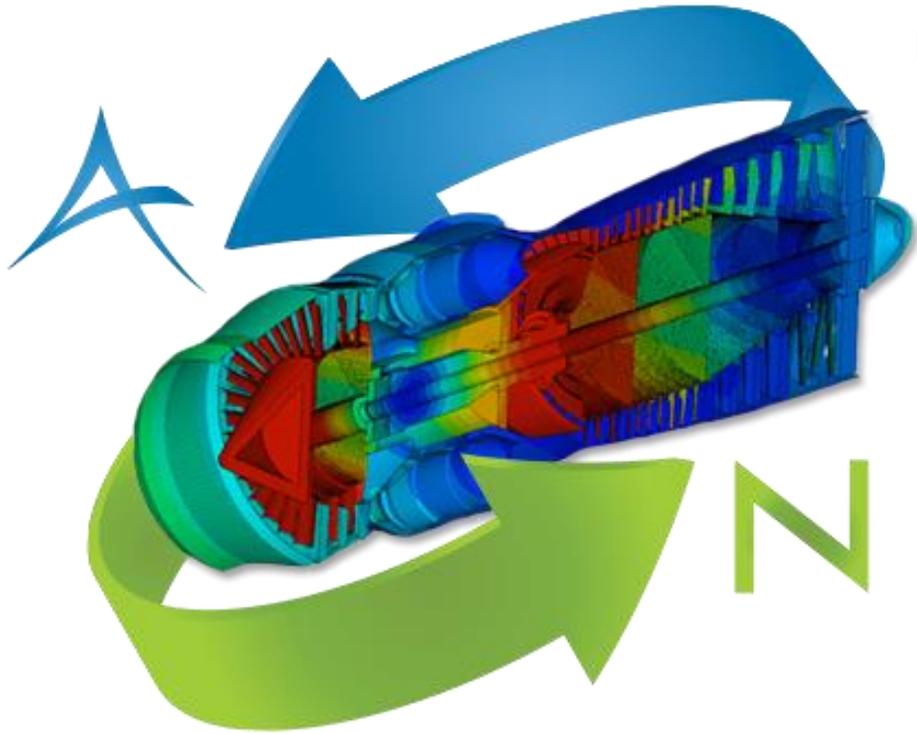


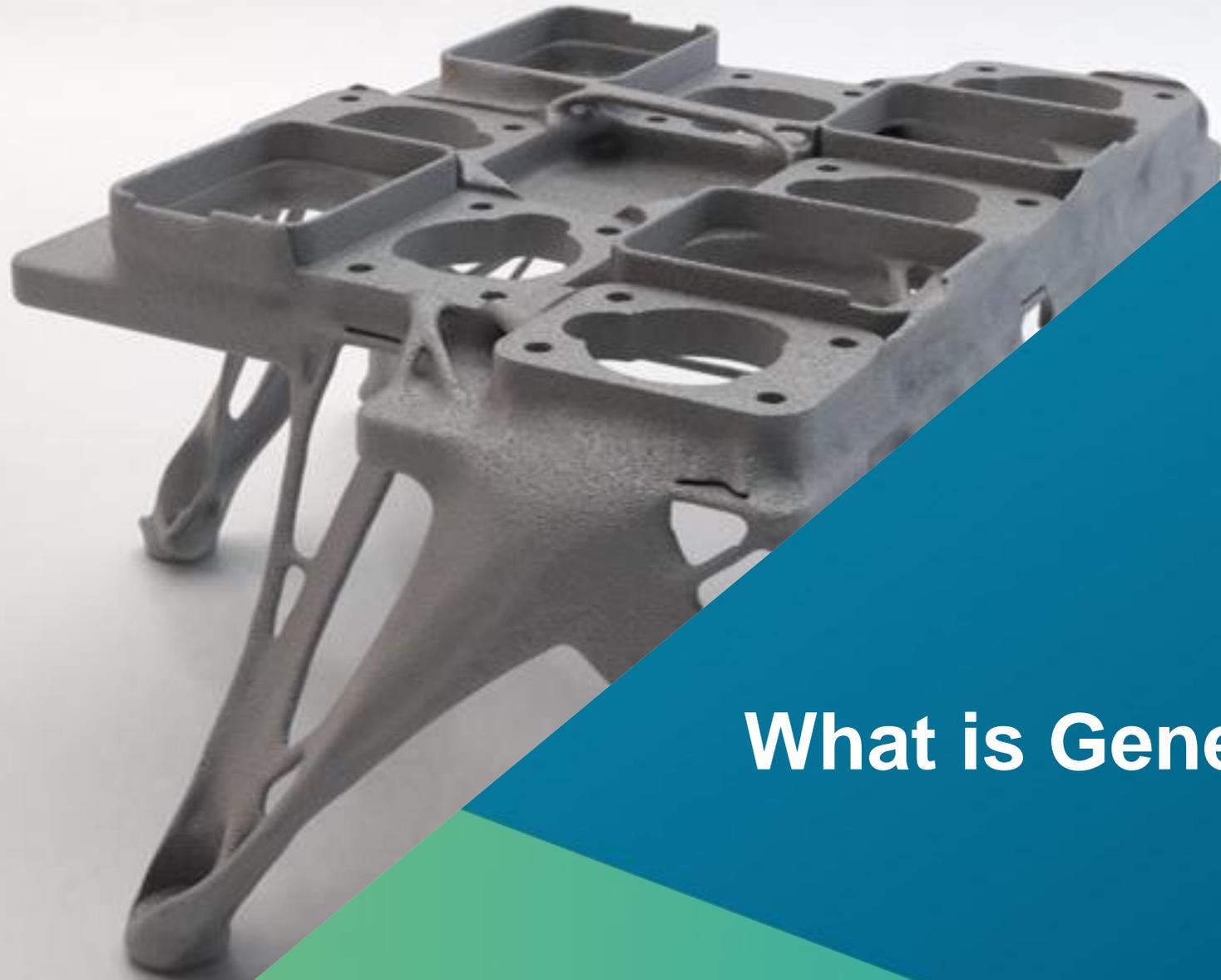
Fast and  
Accurate  
Solution



Integrated  
Solver For  
Analysis  
Readiness

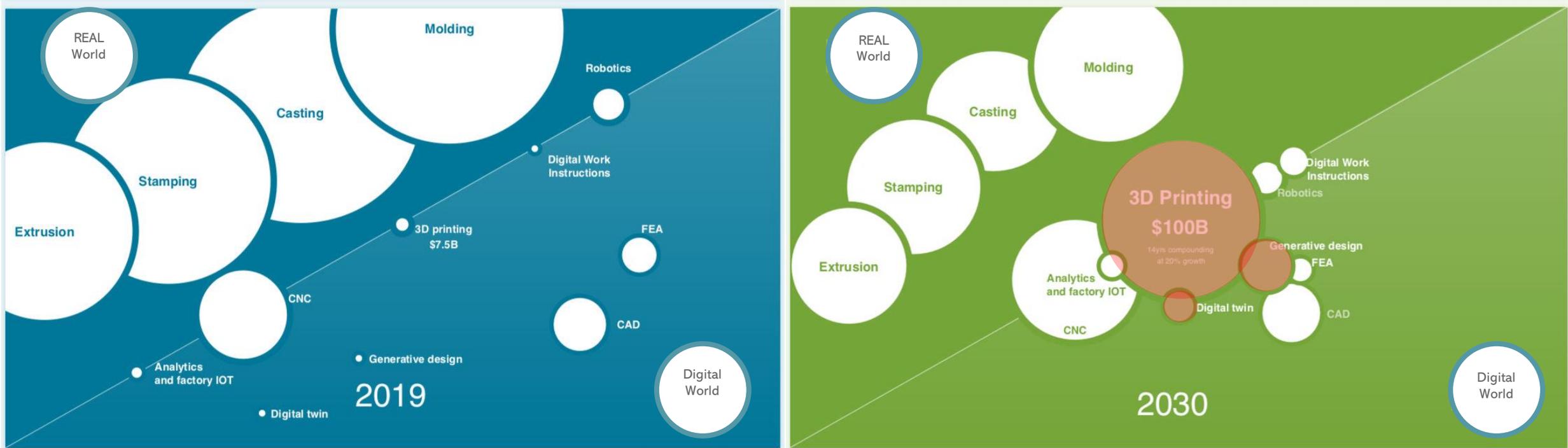
# MSC Apex – How is it Being Used Today for MSC Nastran?





# What is Generative Design?

# Expected Transformation of the Manufacturing Industry within 20 years



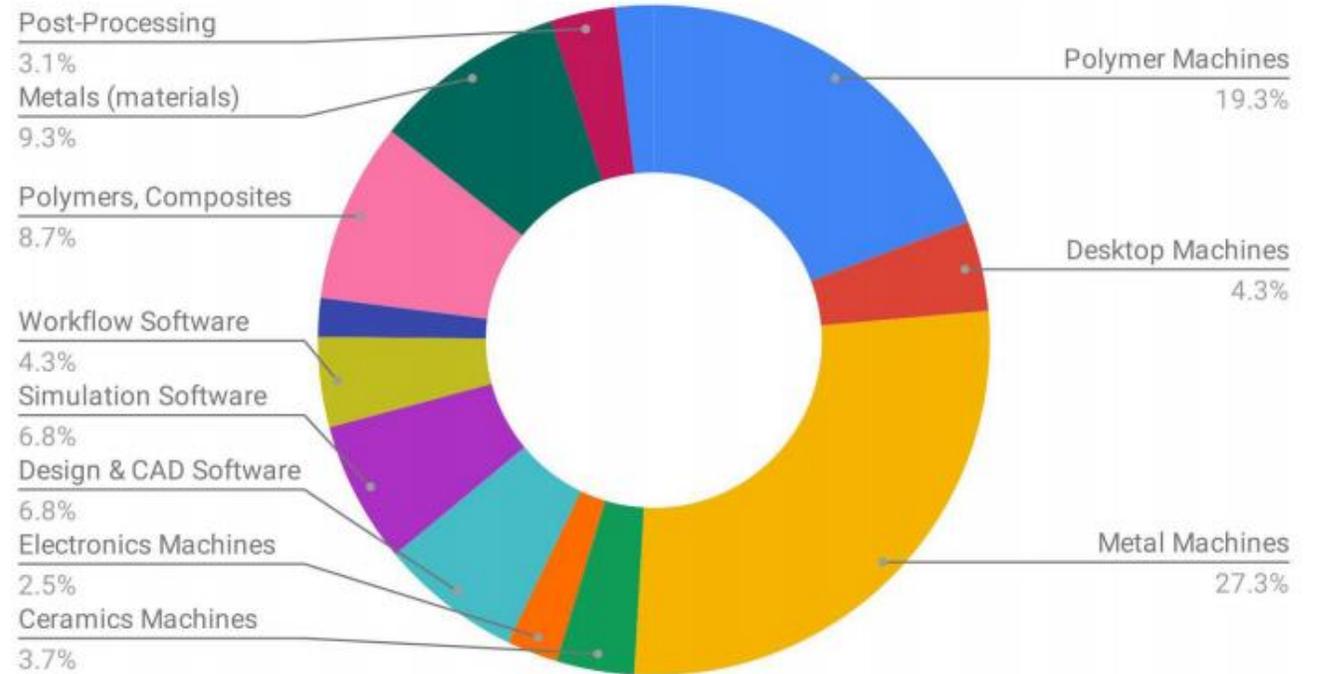
**“Generative Design Market** size is expected to grow from \$111 million (2018) to \$275 million by 2023 at a CAGR of 19.9% during the forecast period.”

# The Additive Manufacturing Industry: At-A-Glance

- Metals make up 27.3% of the overall AM landscape.
- Polymers come in a close second at 19.3% of the overall landscape.

**“As additive manufacturing industrializes, software is playing an increasingly significant role across all areas of the AM workflow.”**

**“While design, CAD and simulation have always been a requirement, the production of industrial-grade and lightweight parts requires software that can adequately cope with the specific requirements of the additive manufacturing process. As a result, software used for design and product development is becoming more advanced out of necessity, leveraging technologies like generative design and topology optimization.”**



Above: A breakdown of the AM landscape, featuring the hardware, software, materials, post-processing systems, QA & process inspection categories. Source: AMFG



**“Generative Design is a new disruptive technology that delivers a paradigm shift for the design and engineering of new products. The conventional design cycle has well-defined steps that include definition, research, specification, design, development, test, revise and revise again until a suitable product is developed. Generative Design is an innovation that significantly alters this way of thinking. It leverages topology optimization, artificial intelligence, and advanced simulation which automatically creates multiple viable design alternatives by specifying simple design criteria.”**



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“Generative Design is a new **disruptive technology** that delivers a paradigm shift for the **design and engineering of new products**. The conventional design cycle has well-defined steps that include definition, research, specification, design, development, test, revise and revise again until a suitable product is developed. Generative Design is an innovation that significantly alters this way of thinking. It leverages **topology optimization, artificial intelligence, and advanced simulation** which automatically **creates multiple viable design alternatives** by specifying simple design criteria.”



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# Generative Design is:

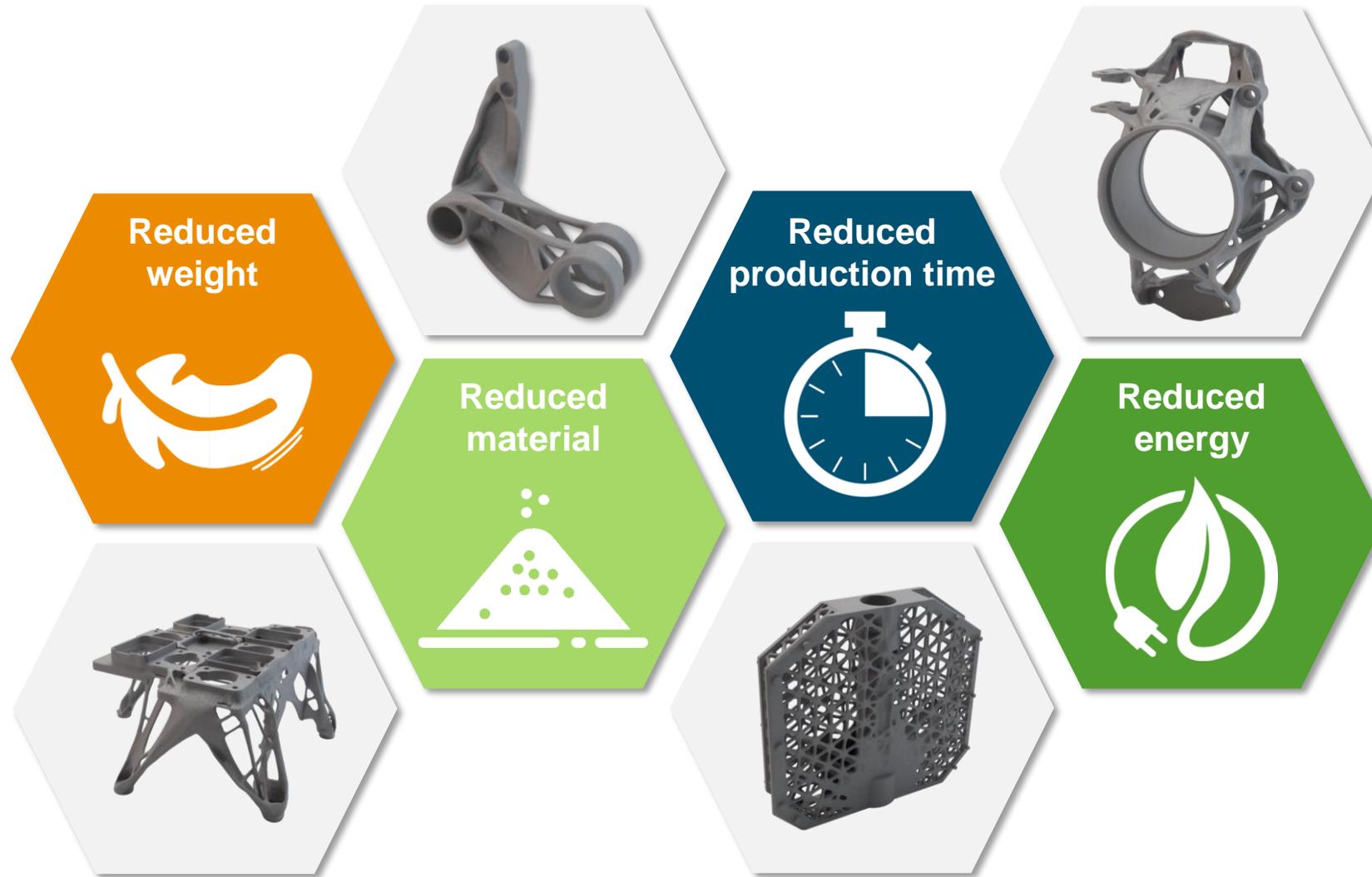
**What:** Disruptive technology

**For:** design and engineering of new products

**Tech:** Topology optimization, artificial intelligence, and advanced simulation

**Result:** Creates multiple viable design alternatives

# Design for Sustainability





## What is MSC Apex Generative Design, and how does it fit into the Additive Workflow?



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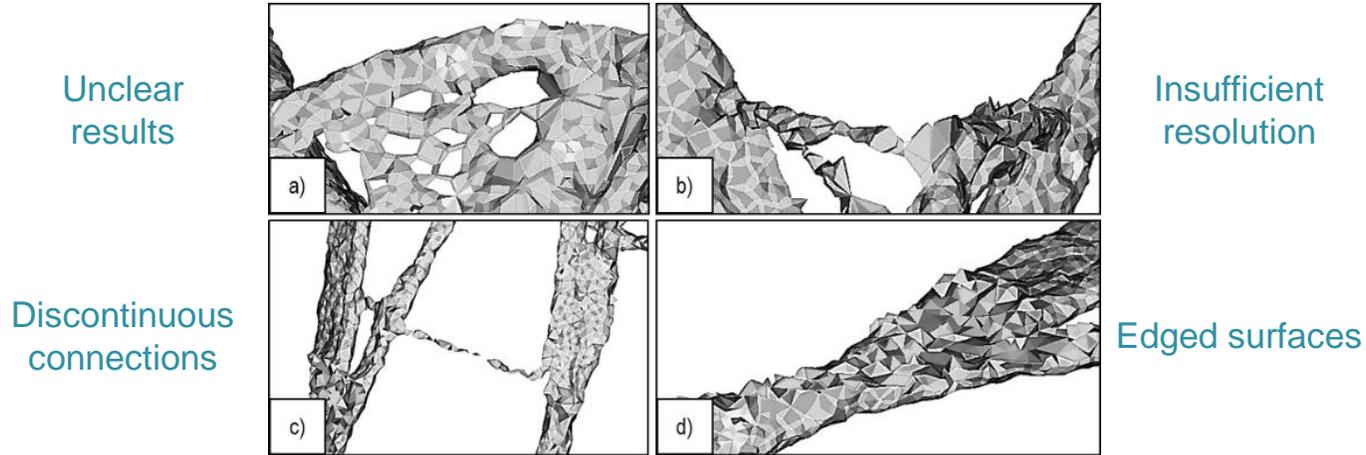
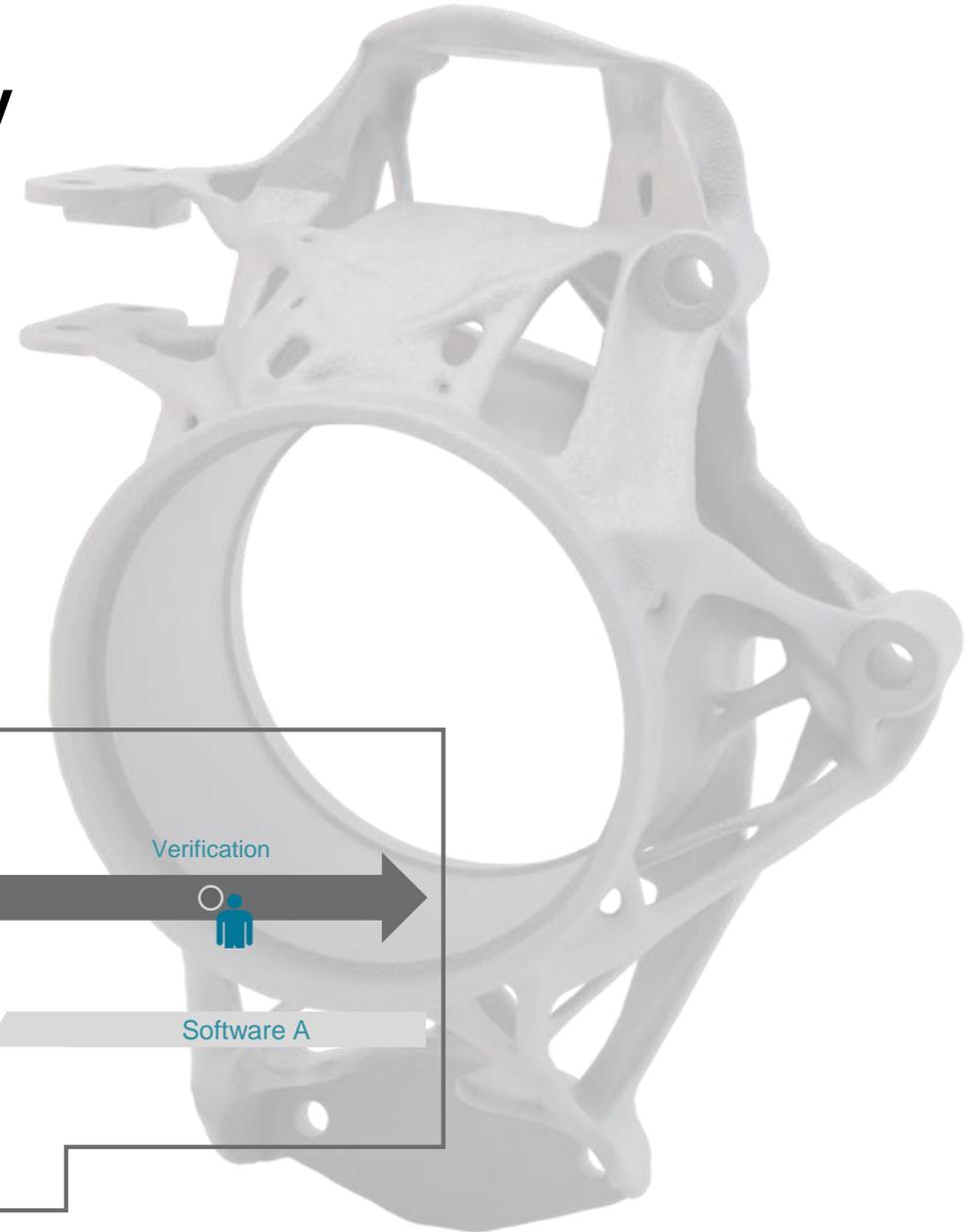


Topology optimization is  
**lengthy** and **complex**

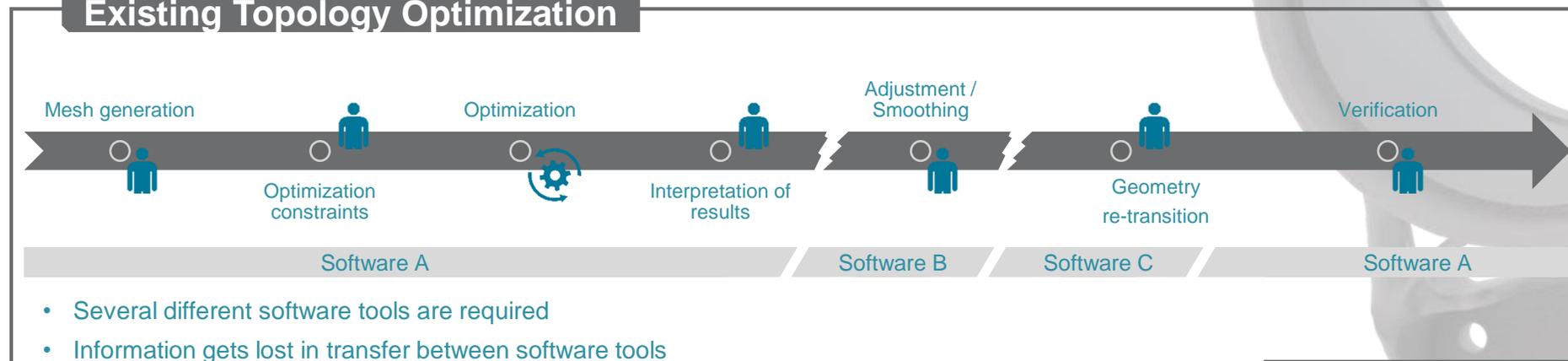
**Expert** knowledge and  
**special** software **required**

CAD Software is **not capable** of  
handling high **complex designs**

# Topology Optimization – Where it Stands Today



## Existing Topology Optimization

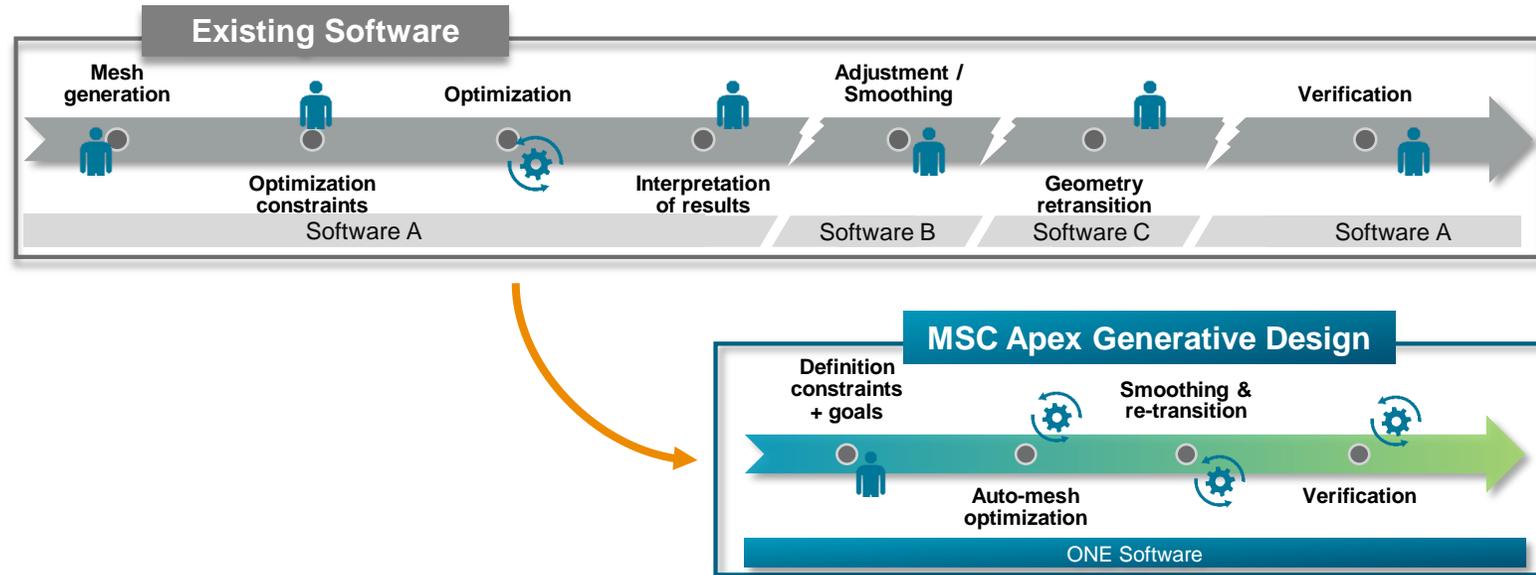


- Several different software tools are required
- Information gets lost in transfer between software tools
- Current process requires a high amount of manual effort, and has a low amount of automation

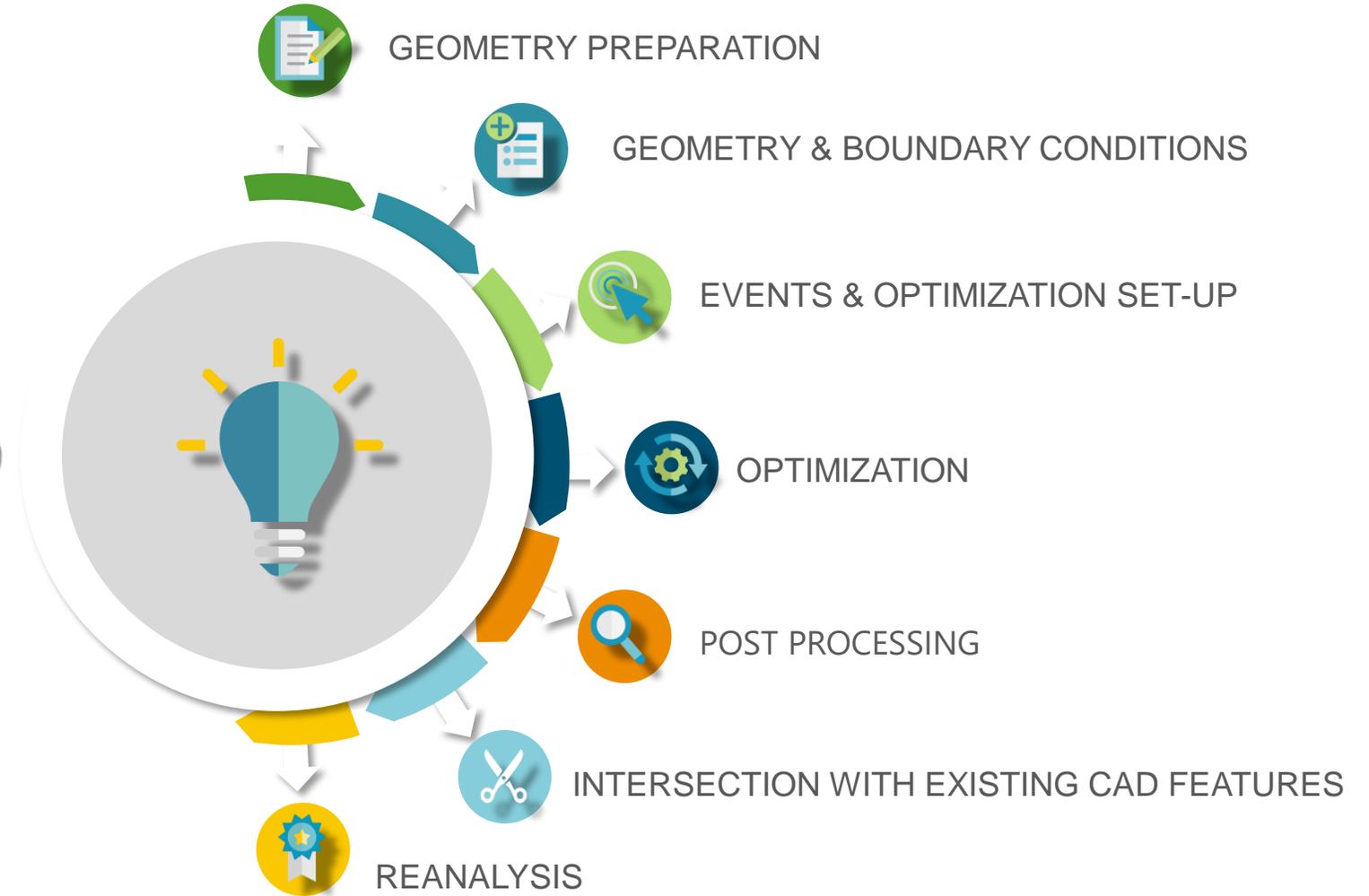
# Applying Lean Principles to Generative Design

“State of the Art” just wasn’t good enough...

- Designing a part for Additive Manufacturing is not intuitive
- Existing Topology Optimization software is highly complex and requires expert knowledge
- Existing CAD software has a hard time with freeform geometry – they tend to only support feature-based CAD, which can make the AM workflow complex and time consuming
- Most geometries predicted by Topology Optimization will fail in a 3d printer and/or have sub-par strength and stiffness characteristics



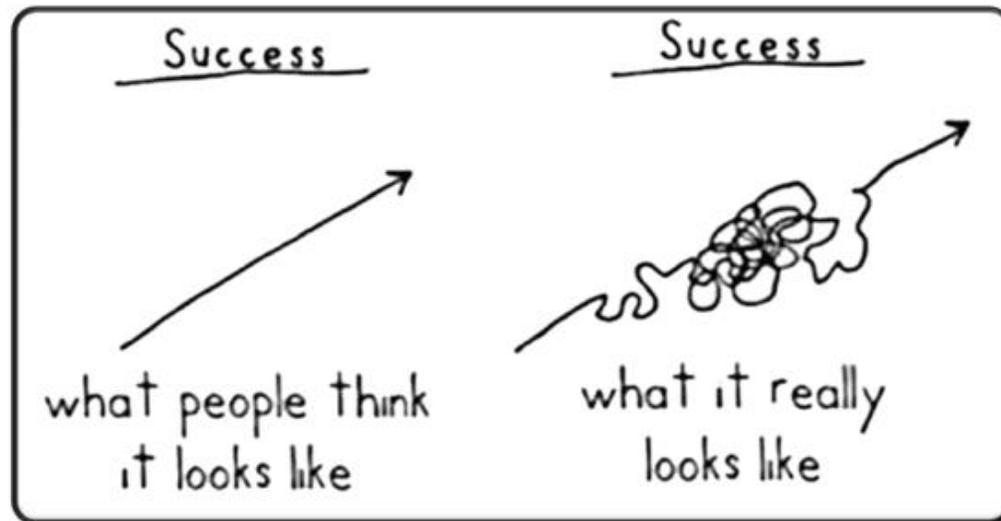
# MSC Apex Generative Design Workflow



# Variety is key for successful designs

Generating design candidates is not a straightforward process (even though it might look that way to outsiders...)

- Different design variants increase the chance for an optimum final design
- Faster software means more time to run different options, and thus get more design variants
- In the end, you get better results in significantly less time



# Design Funnel

1

## STRESS

Designs must meet the stress limitation

2

## WEIGHT

Designs that are too heavy cause higher costs for materials and energy

3

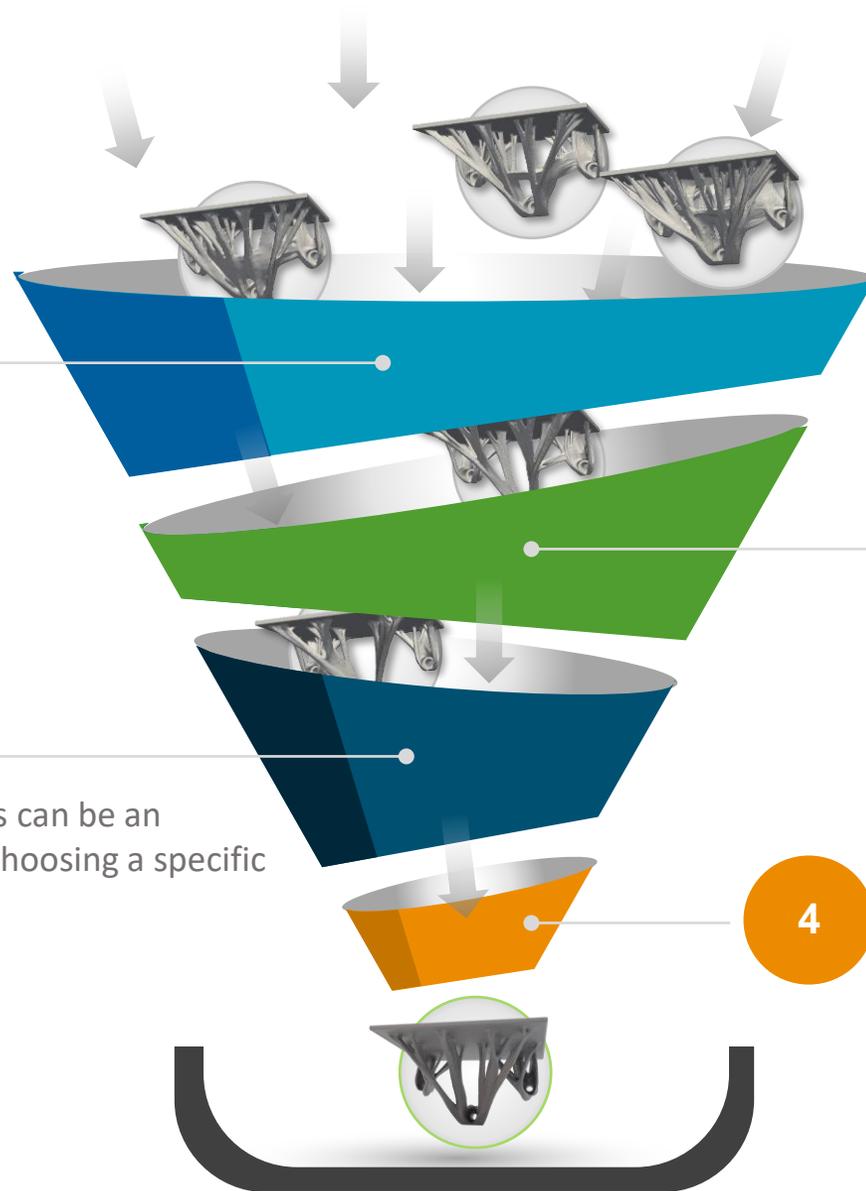
## DESIGN

Design and aesthetics can be an important aspect in choosing a specific variant

4

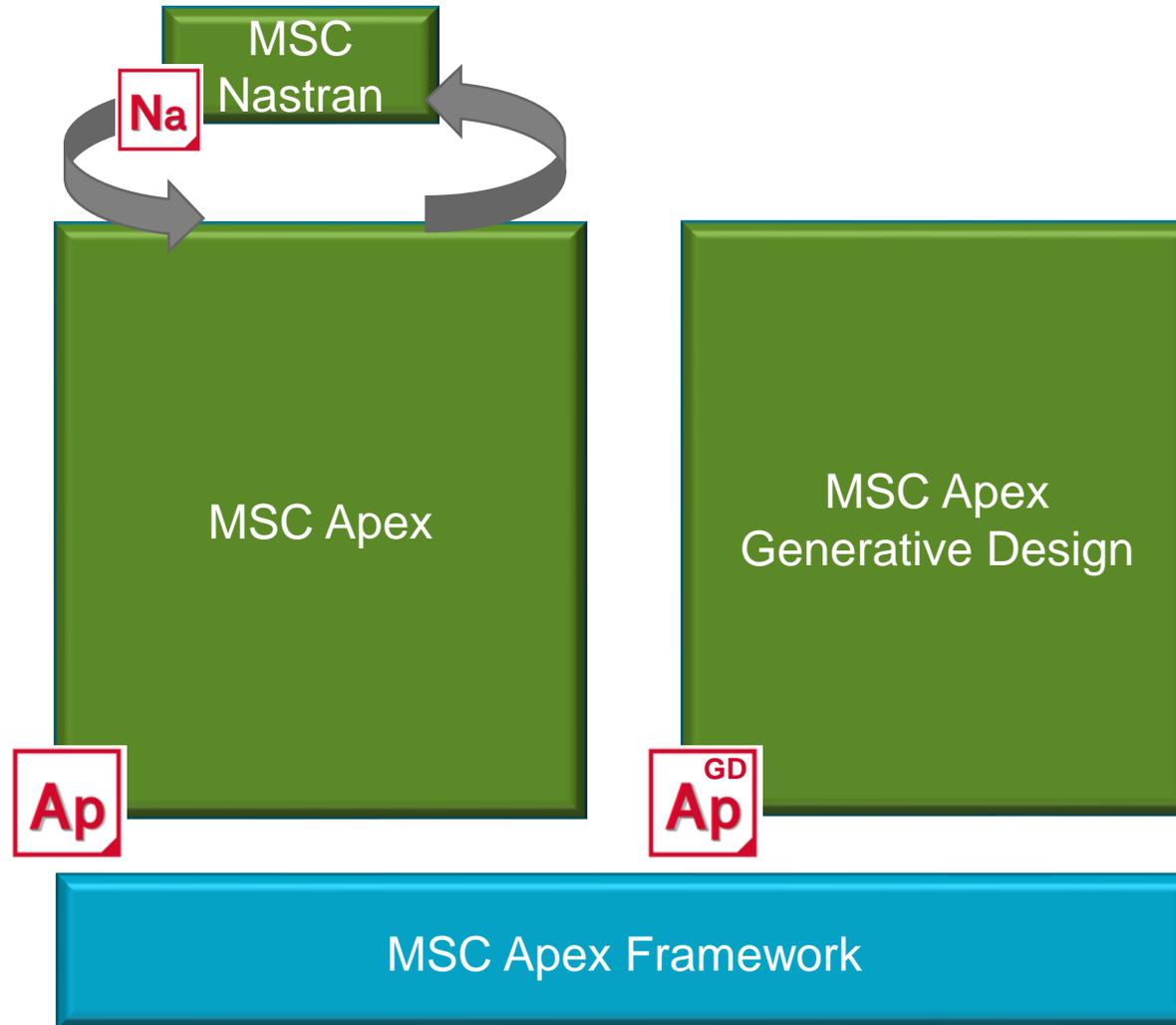
## MANUFACTURING

Some designs are easier to manufacture than others, highly depending on the design and process

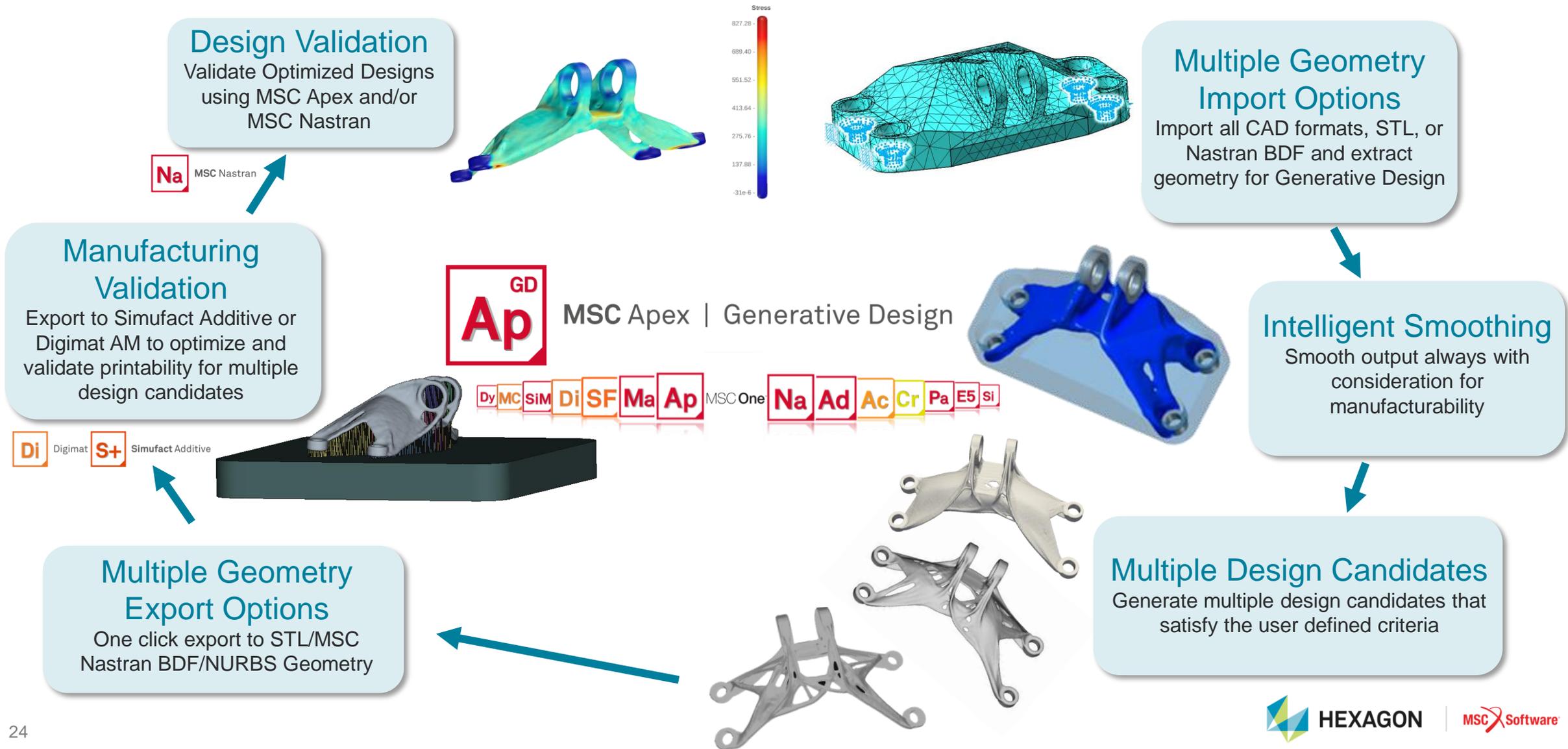


# MSC Apex Generative Design

View of **MSC Apex** Products



# MSC Apex Generative Design – Supporting the Entire AM Workflow





**How has this product helped  
Customers Today?**

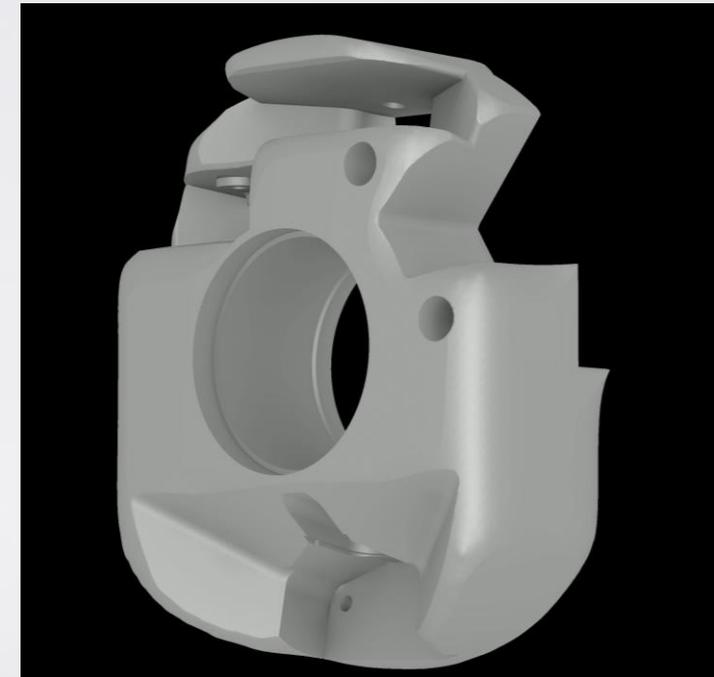
# Case study: Wheel Carrier

## Formula SAE Wheel Mount

48% weight reduction 

14 hrs solve time 

Zero material waste 



# Case study: Satellite Bracket

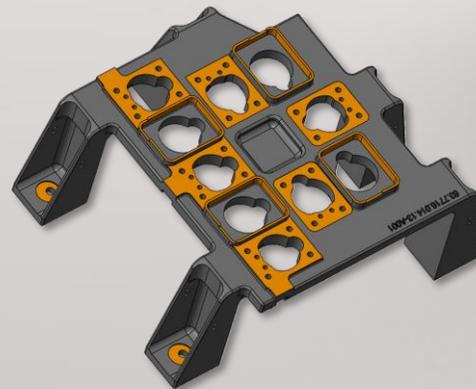
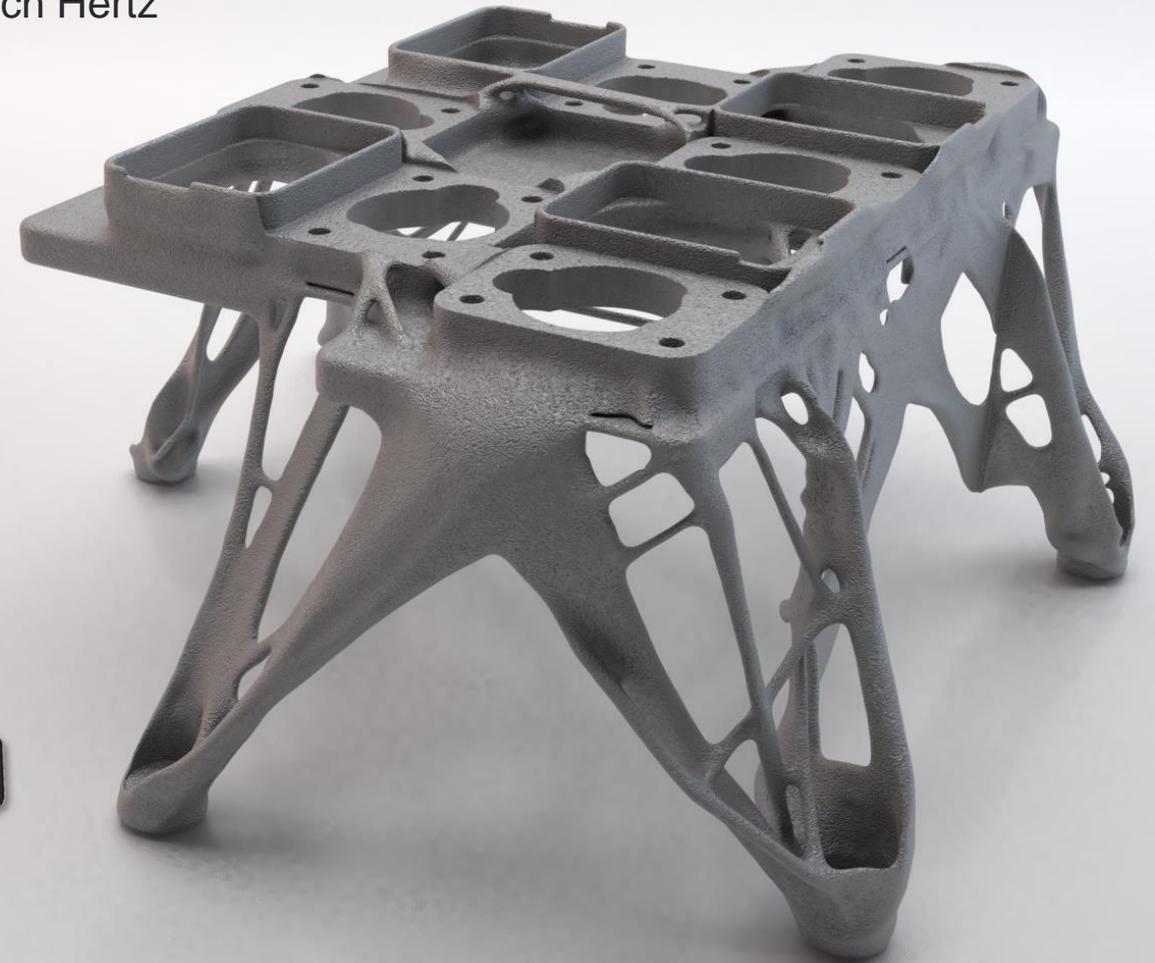
## Mounting of drives for regulating microwave filters

To be used in the German communications satellite Heinrich Hertz

55% weight reduction 

31% stress reduction 

79% stiffness increase 



# Case study: EDAG LightHinge+

70% weight reduction +

40% lighter than  
conventional optimization +

60% time savings vs.  
conventional optimization +



# Case study: DMRC Aerospace Bracket

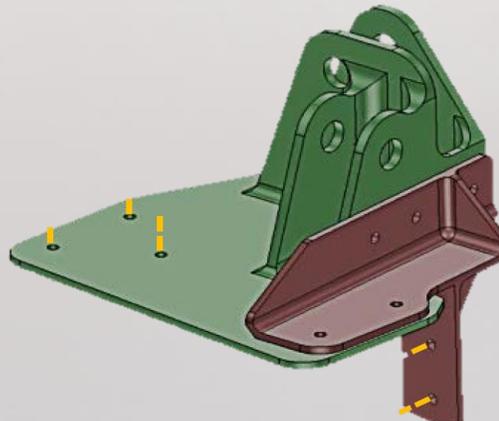
63% weight reduction

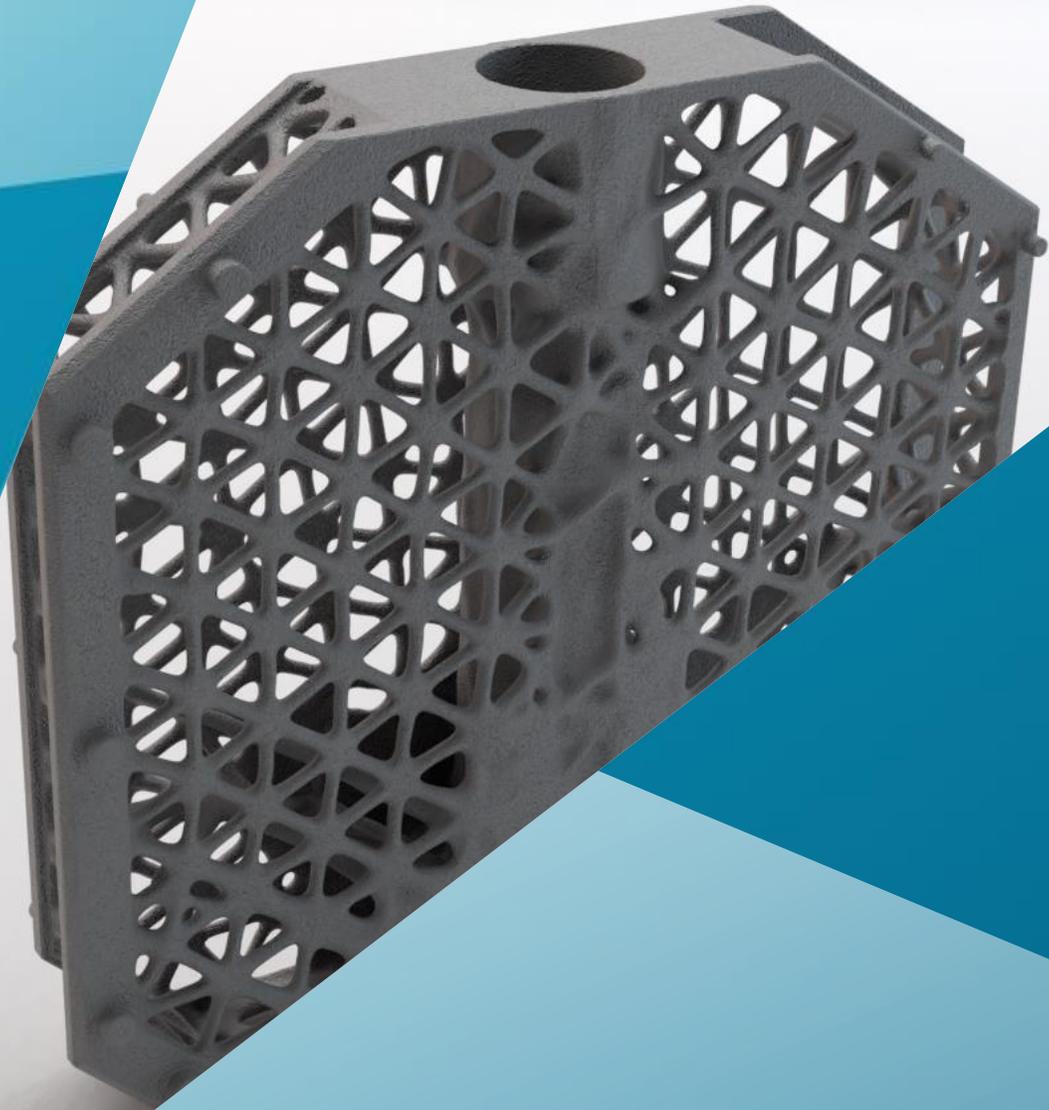


2.5 hour calculation time



Reduced connection locations from 6 to 4



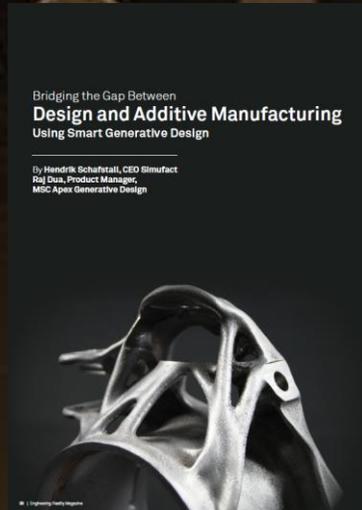


# DEMONSTRATION

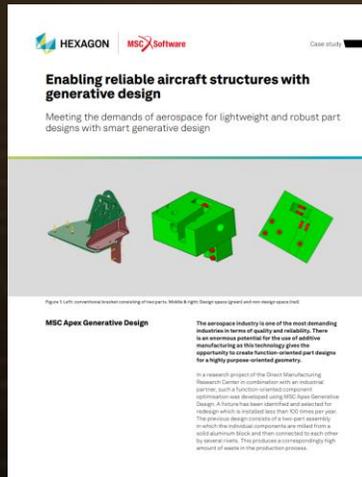
# Generative Design – A new Mindset for Design

Do you want to know more?

Whitepaper & e-Book:



Case Studies:





# Where Simulation Gets Real

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