

IM473670

Generative Design in Fusion 360: A Year in Review and a Look Ahead

Mike Smell

Sr. Product Manager, Fusion 360 | [linkedin.com/in/mikesmell/](https://www.linkedin.com/in/mikesmell/)

Brian Frank

Sr. Product Manager, Fusion 360 | [linkedin.com/in/bmfrank/](https://www.linkedin.com/in/bmfrank/)



Mike Smell

Sr. Product Manager, Fusion 360

Mike has been a member of the Fusion 360 Product Management team for 5 years and is currently focused on Generative Design. Mike has spent nearly 14 years in the CAD and CAE industry, starting his career at Algor, Inc. in 2006, eventually being acquired by Autodesk in 2009. Mike holds a BS in Mechanical Engineering from the Pennsylvania State University and a Masters in Mechanical Engineering from the University of Pittsburgh. Mike has been a regular presenter at Autodesk University since 2009.



Brian M. Frank

Sr. Product Line Manager

Brian M. Frank is Sr. Product Line Manager for Generative Design solutions at Autodesk. Having held various roles within Autodesk since joining in 2008, Brian focuses on the development of simulation products and next generation technologies, including finite element analysis (FEA), computational fluid dynamics (CFD), and Generative Design offerings from Autodesk.

Agenda

- Generative Design Foundations
- 2020 Accomplishments
- Customer Success
- Looking Ahead



What is Generative Design

Generative design is a **design exploration** technology available in **Fusion 360**.

Simultaneously generate multiple CAD-ready solutions based on real-world manufacturing constraints, cost evaluation and product performance requirements



Multiple Design Solutions in Parallel

 <p>Study 1 - Generative - Outcome ... 3.56 in³</p>	 <p>Study 1 - Generative - Outcome 1 3.56 in³</p>	 <p>Study 3 - Generative - Outcome 1 3.57 in³</p>	 <p>Study 1 - Generative - Outcome ... 3.58 in³</p>	 <p>Study 3 - Generative - Outcome 9 3.59 in³</p>	 <p>Study 1 - Generative - Outcome ... 3.59 in³</p>	 <p>Study 1 - Generative - Outcome ... 3.59 in³</p>	 <p>Study 1 - Generative - Outcome ... 3.59 in³</p>	 <p>Study 1 - Generative - Outcome ... 3.6 in³</p>	 <p>Study 1 - Generative - Outcome ... 3.6 in³</p>	 <p>Study 3 - Generative - Outcome ... 3.83 in³</p>	 <p>Study 3 - Generative - Outcome ... 3.85 in³</p>	 <p>Study 3 - Generative - Outcome ... 3.88 in³</p>	 <p>Study 1 - Generative - Outcome 4 3.92 in³</p>
 <p>Study 3 - Generative - Outcome ... 3.94 in³</p>	 <p>Study 1 - Generative - Outcome ... 4.03 in³</p>	 <p>Study 3 - Generative - Outcome ... 4.04 in³</p>	 <p>Study 3 - Generative - Outcome ... 4.05 in³</p>	 <p>Study 1 - Generative - Outcome 3 4.13 in³</p>	 <p>Study 1 - Generative - Outcome ... 4.15 in³</p>	 <p>Study 1 - Generative - Outcome ... 4.21 in³</p>	 <p>Study 1 - Generative - Outcome 2 4.22 in³</p>	 <p>Study 1 - Generative - Outcome ... 4.27 in³</p>	 <p>Study 1 - Generative - Outcome ... 4.3 in³</p>	 <p>Study 3 - Generative - Outcome 4 4.34 in³</p>	 <p>Study 3 - Generative - Outcome ... 4.43 in³</p>	 <p>Study 3 - Generative - Outcome 3 4.53 in³</p>	 <p>Study 3 - Generative - Outcome ... 4.66 in³</p>
 <p>Study 3 - Generative - Outcome ... 4.71 in³</p>	 <p>Study 3 - Generative - Outcome ... 4.78 in³</p>	 <p>Study 3 - Generative - Outcome 2 4.88 in³</p>	 <p>Study 1 - Generative - Outcome ... 4.88 in³</p>	 <p>Study 4 - More Loads - Outcom... 5.13 in³</p>	 <p>Study 3 - Generative - Outcome ... 5.19 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 5.2 in³</p>	 <p>Study 3 - Generative - Outcome ... 5.24 in³</p>	 <p>Study 3 - Generative - Outcome ... 5.25 in³</p>	 <p>Study 1 - Generative - Outcome ... 5.27 in³</p>	 <p>Study 4 - More Loads - Outcom... 5.39 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 5.53 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 5.54 in³</p>	 <p>Study 4 - More Loads - Outcom... 5.57 in³</p>
 <p>Study 4 - More Loads - Outcom... 5.68 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 5.73 in³</p>	 <p>Study 5 - More Loads Higher Sy... 5.79 in³</p>	 <p>Study 5 - More Loads Higher Sy... 5.81 in³</p>	 <p>Study 5 - More Loads Higher Sy... 5.93 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 5.96 in³</p>	 <p>Study 4 - More Loads - Outcom... 6.02 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 6.06 in³</p>	 <p>Study 5 - More Loads Higher Sy... 6.07 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 6.08 in³</p>	 <p>Study 4 - More Loads - Outcom... 6.11 in³</p>	 <p>Study 4 - More Loads - Outcom... 6.25 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 6.35 in³</p>	 <p>Study 5 - More Loads Higher Sy... 6.44 in³</p>
 <p>Study 5 - More Loads Higher Sy... 6.52 in³</p>	 <p>Study 4 - More Loads - Outcom... 6.53 in³</p>	 <p>Study 4 - More Loads - Outcom... 6.53 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 6.55 in³</p>	 <p>Study 5 - More Loads Higher Sy... 6.6 in³</p>	 <p>Study 4 - More Loads - Outcom... 6.63 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 6.82 in³</p>	 <p>Study 5 - More Loads Higher Sy... 6.83 in³</p>	 <p>Study 5 - More Loads Higher Sy... 6.84 in³</p>	 <p>Study 5 - More Loads Higher Sy... 6.9 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 6.91 in³</p>	 <p>Study 4 - More Loads - Outcom... 6.98 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 7.08 in³</p>	 <p>Study 4 - More Loads - Outcom... 7.12 in³</p>
 <p>Study 5 - More Loads Higher Sy... 7.15 in³</p>	 <p>Study 3 - Generative - Outcome ... 7.24 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 7.25 in³</p>	 <p>Study 3 - Generative - Outcome 8 7.3 in³</p>	 <p>Study 1 - Generative - Outcome ... 7.32 in³</p>	 <p>Study 3 - Generative - Outcome ... 7.33 in³</p>	 <p>Study 1 - Generative - Outcome ... 7.33 in³</p>	 <p>Study 1 - Generative - Outcome ... 7.34 in³</p>	 <p>Study 1 - Generative - Outcome 6 7.35 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 7.38 in³</p>	 <p>Study 4 - More Loads - Outcom... 7.39 in³</p>	 <p>Study 3 - Generative - Outcome ... 7.4 in³</p>	 <p>Study 5 - Lower Clamp - Outco... 7.4 in³</p>	 <p>Study 4 - More Loads - Outcom... 7.4 in³</p>

Multiple Manufacturing Methods

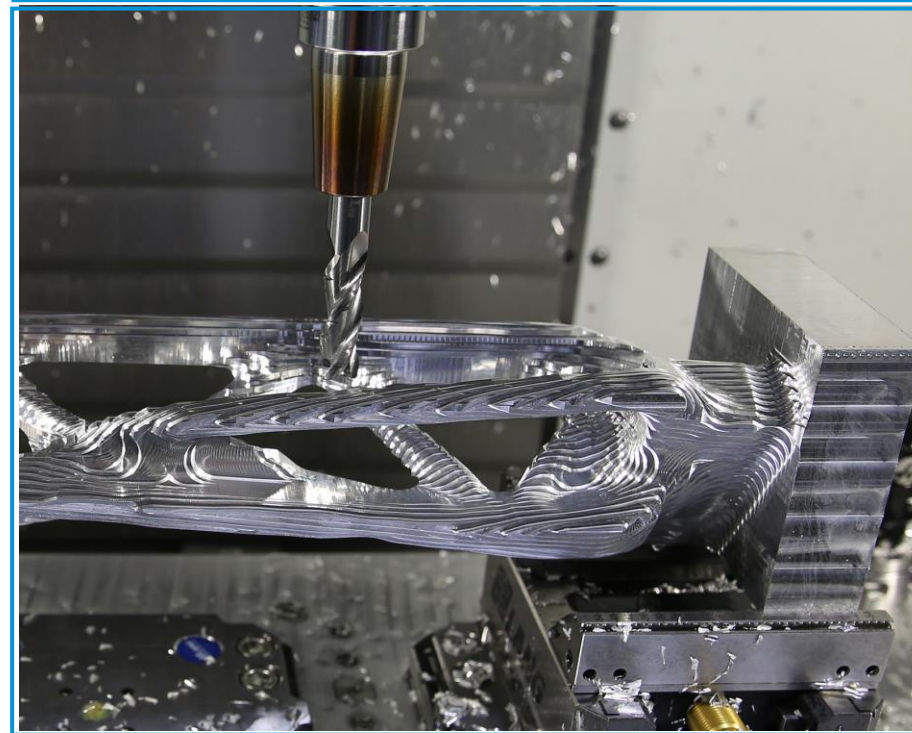
Additive
Manufacturing



Die Casting



3 & 5 Axis Milling



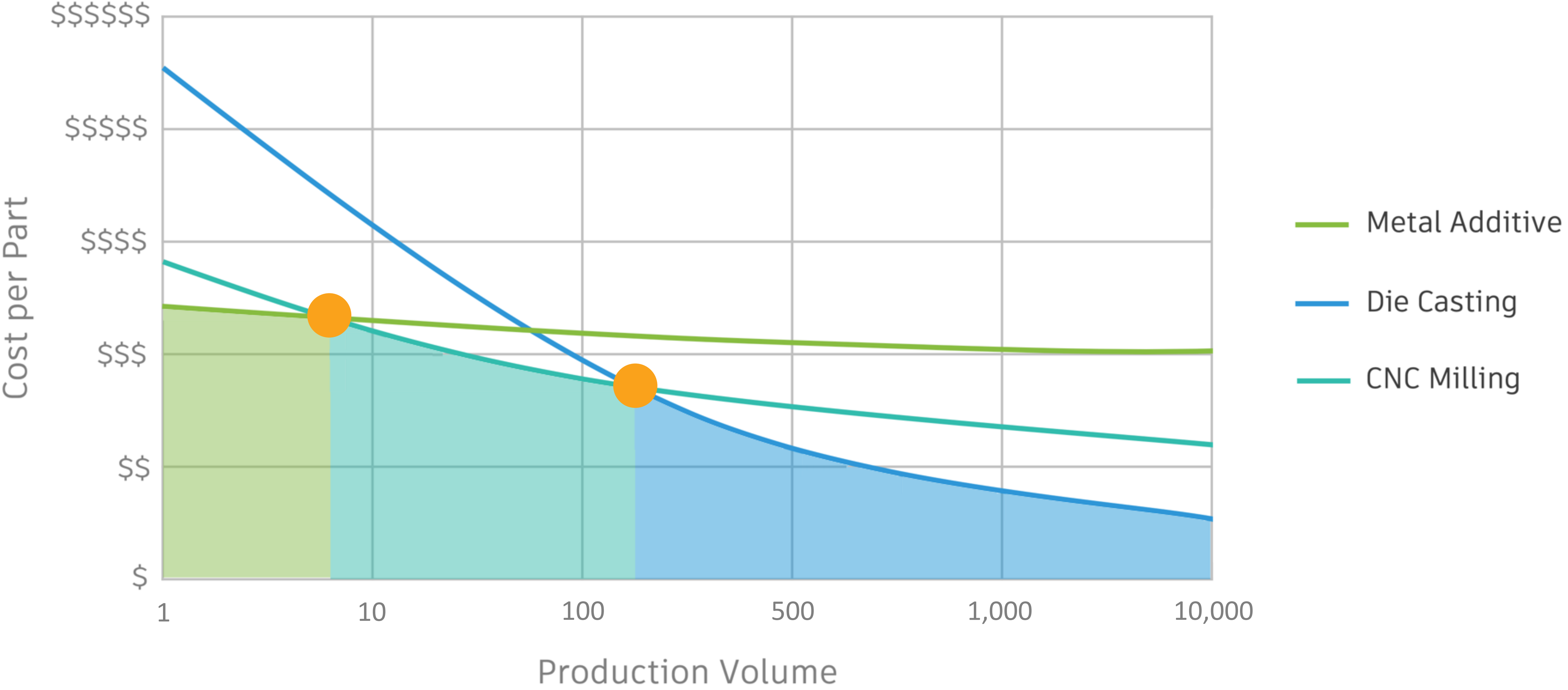
2.5 Axis Milling



2 Axis Cutting



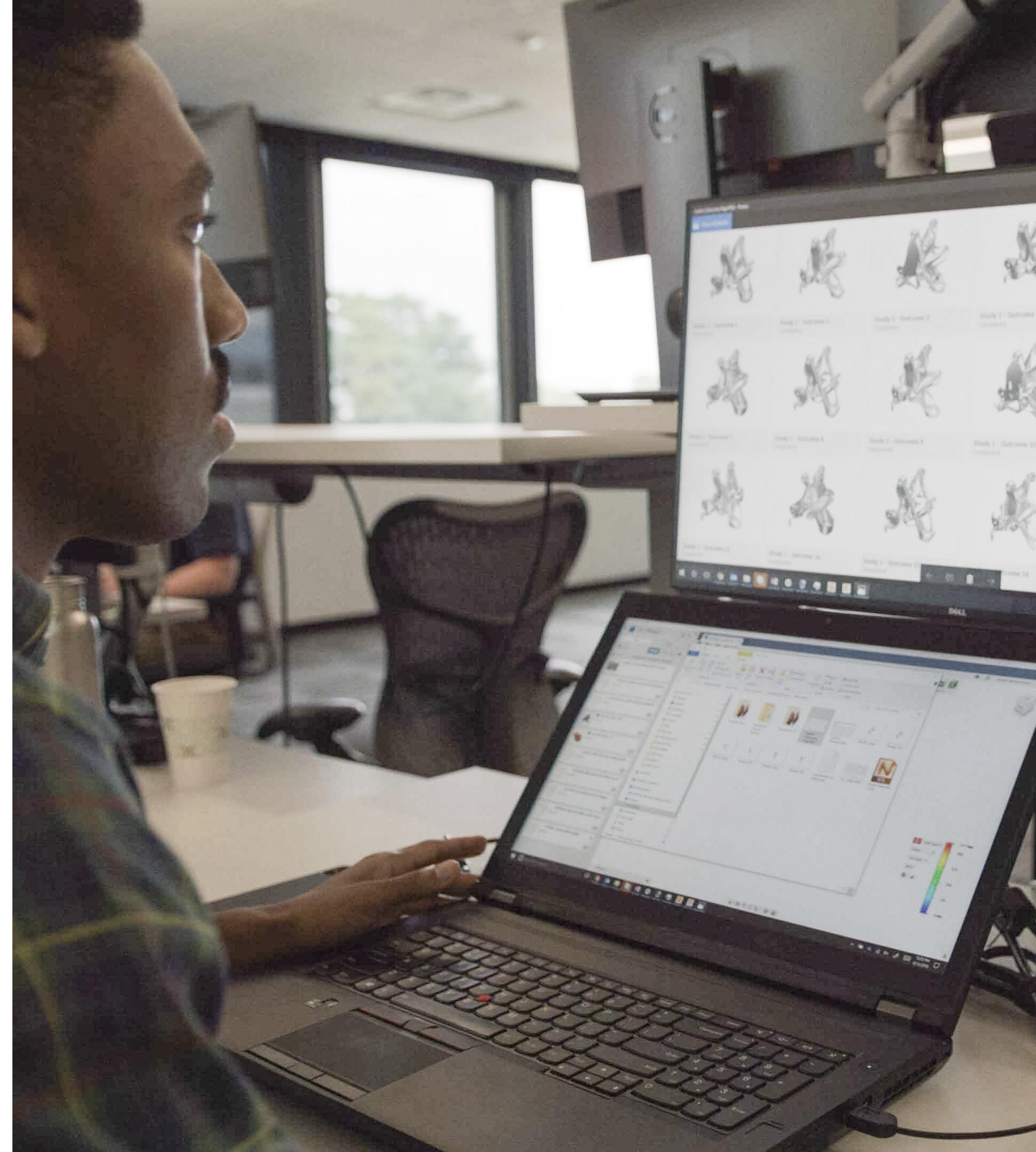
Multiple Cost Insights



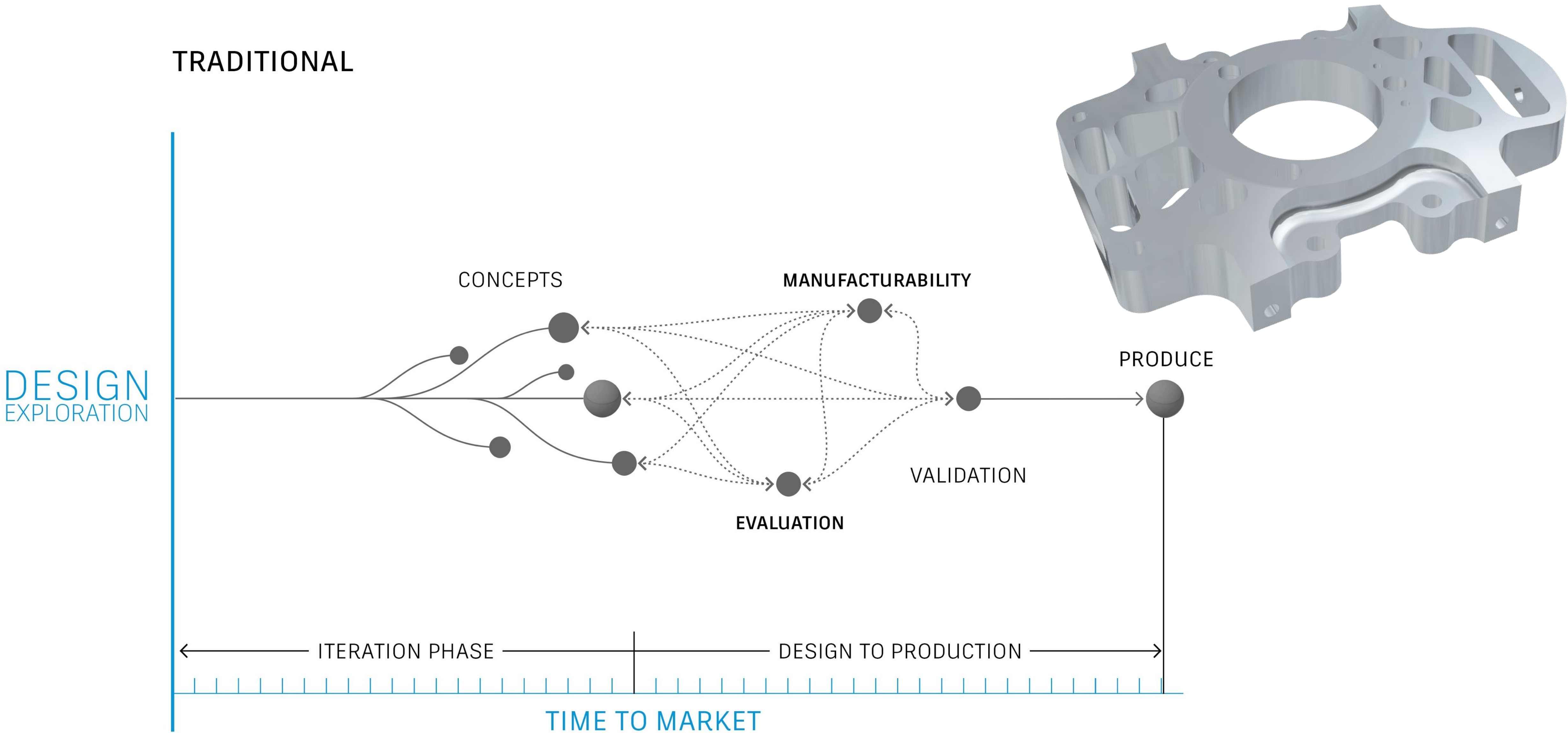
EXISTING BARRIERS TO INNOVATION, PRODUCTIVITY & PROCESS

The ultimate goal for any engineering activity is to strike the **right balance between performance and cost** to produce for a given design challenge or market opportunity.

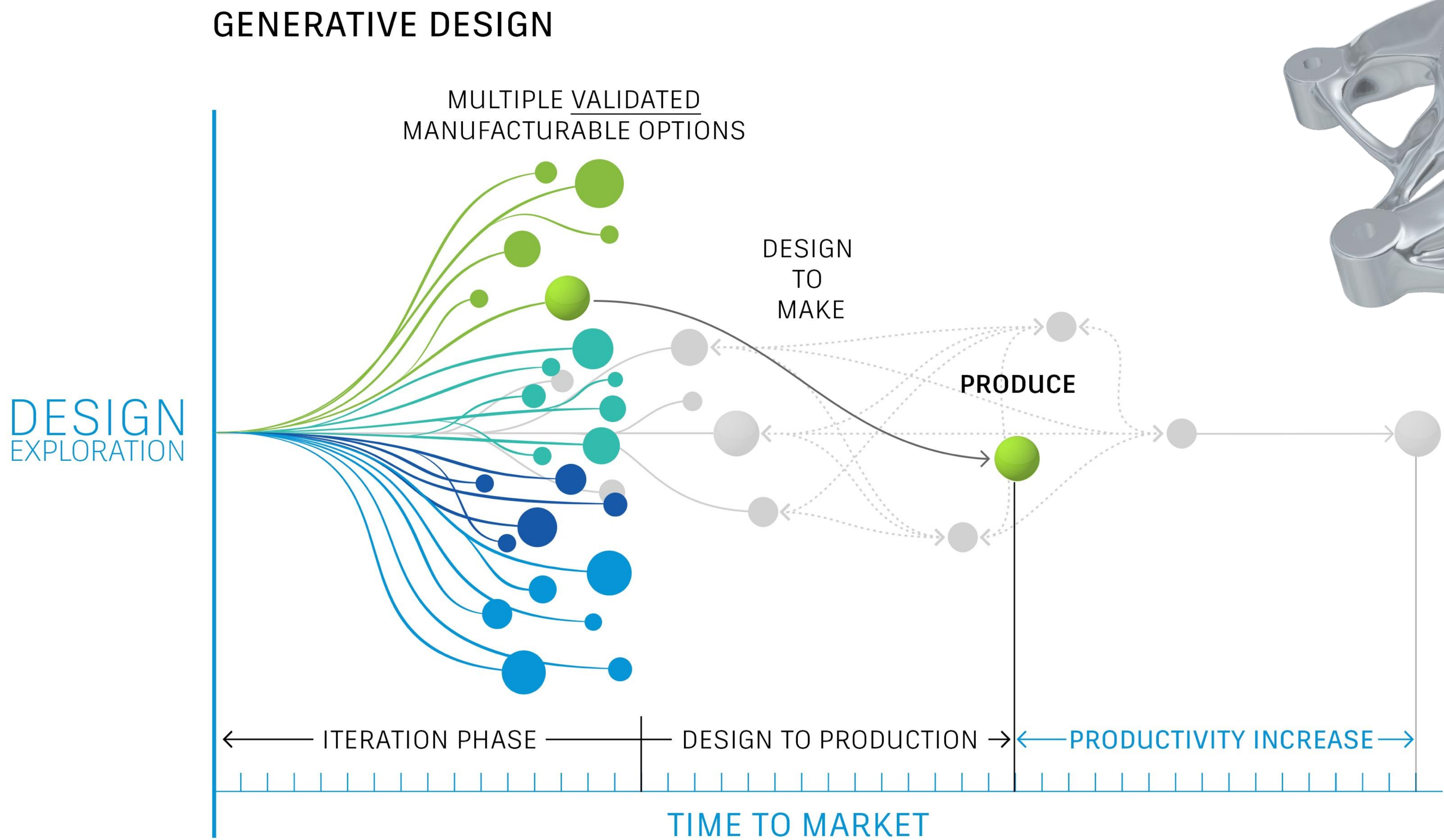
Engineers are limited in the time and energy they can spend on any design problem to fully explore the options that encompass the design space.



The Traditional Product Development Process



Generative Design in Fusion 360

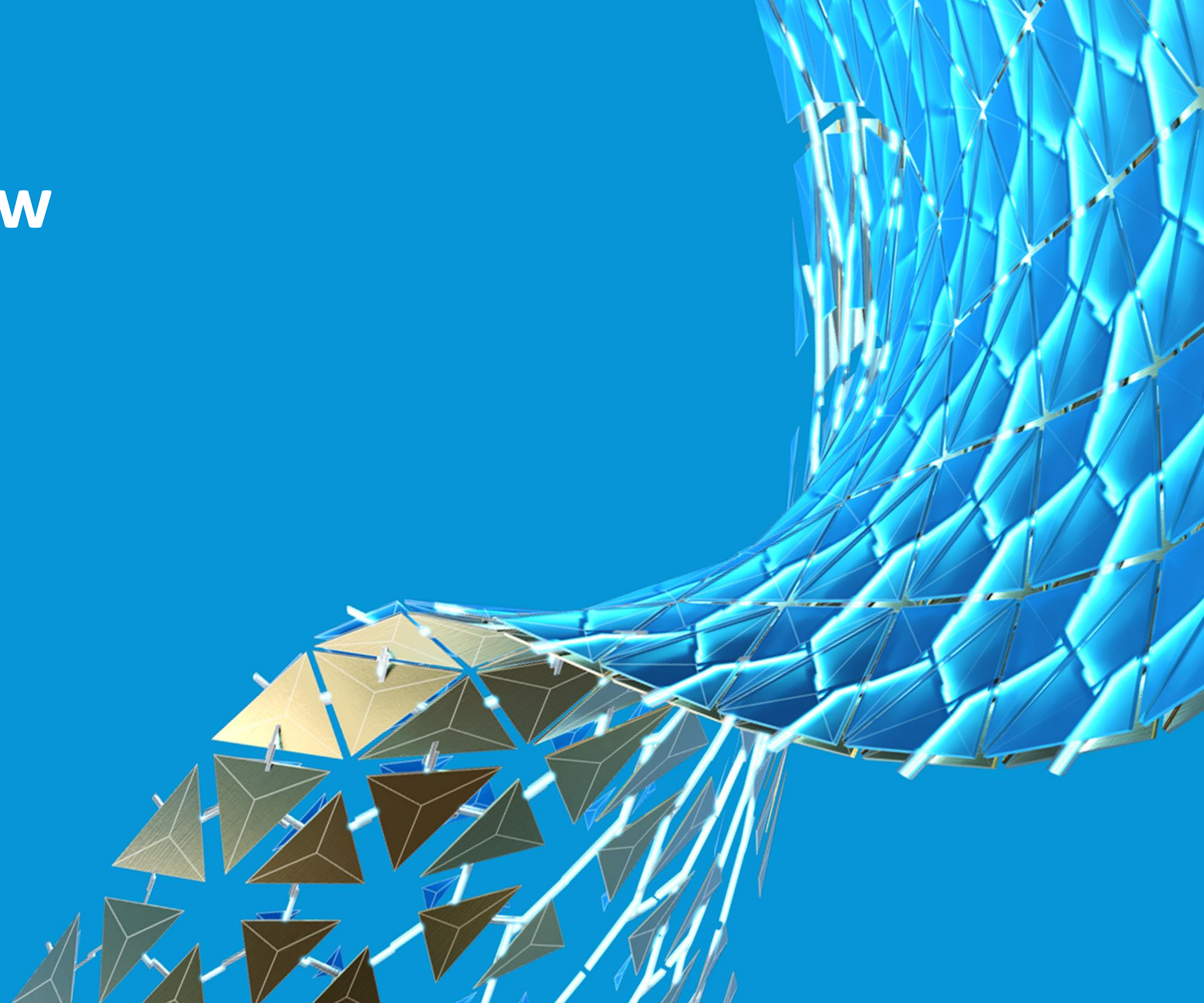


**Generative
Design**



**Better
Engineering**

2020 in Review



2020 Development Focus Areas

**USER
EXPERIENCE**

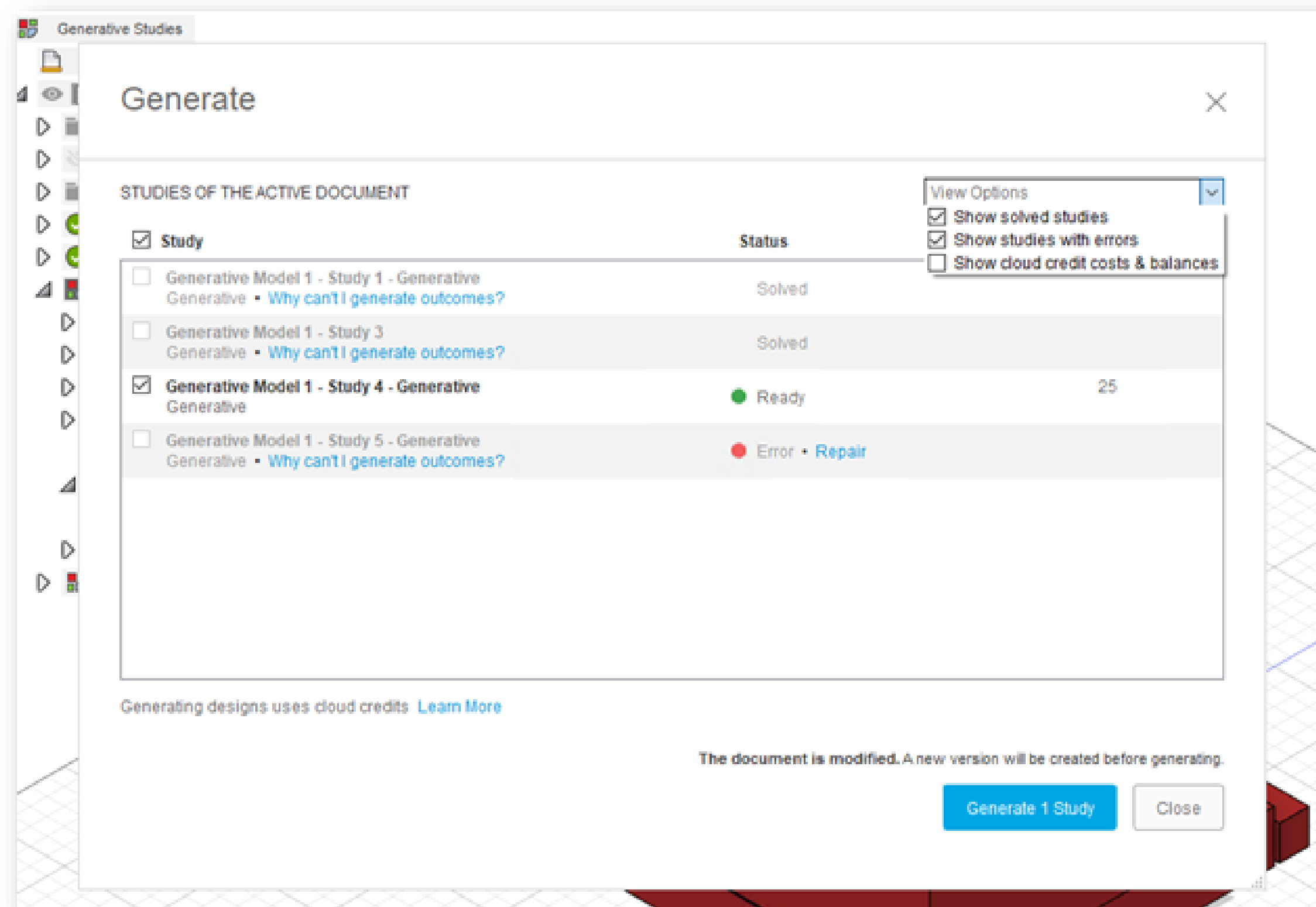
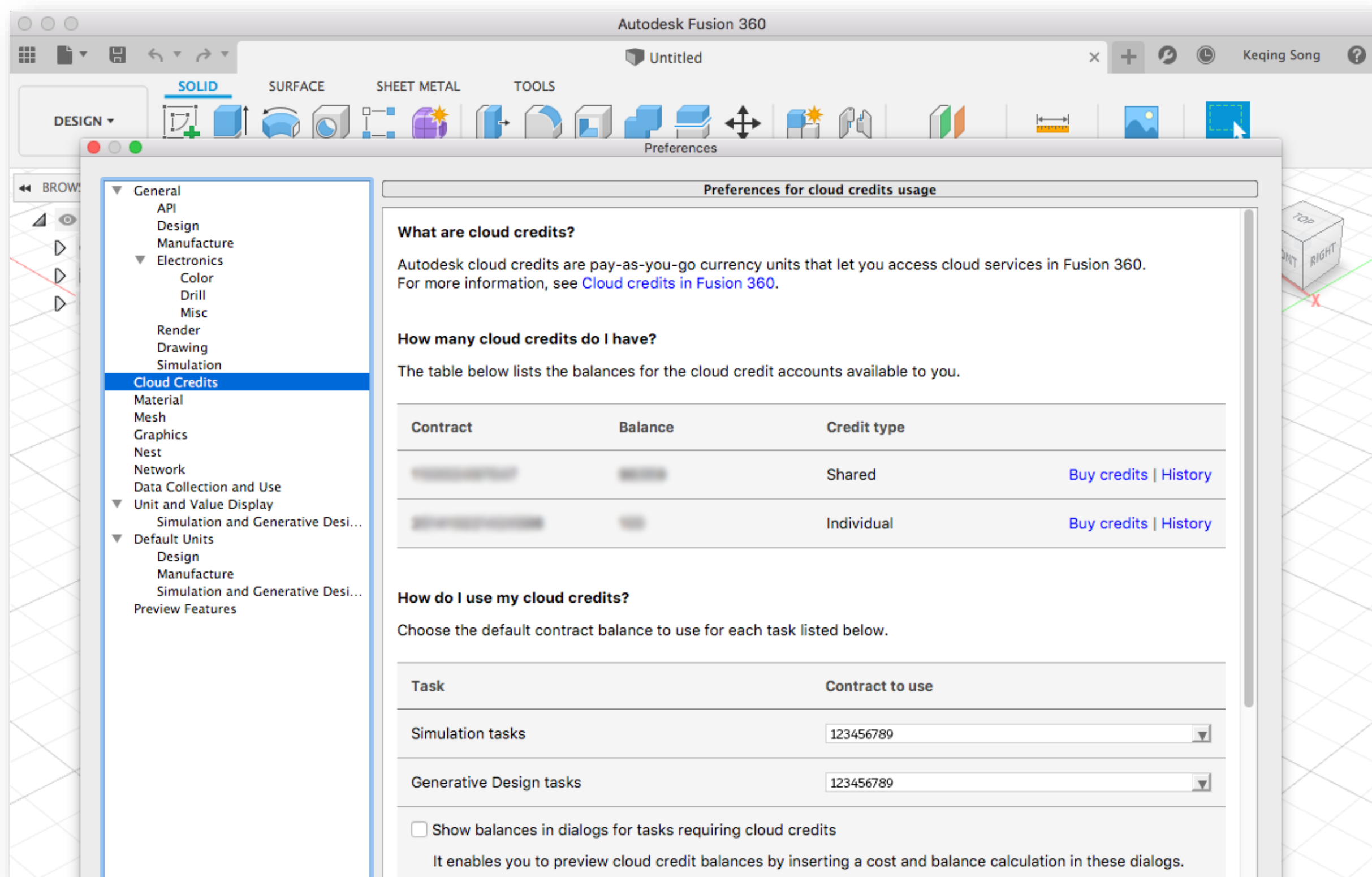
**MANUFACTURING
CONSTRAINTS**

**OUTCOME
EXPERIENCE**

**TECHNOLOGY
PLATFORM**

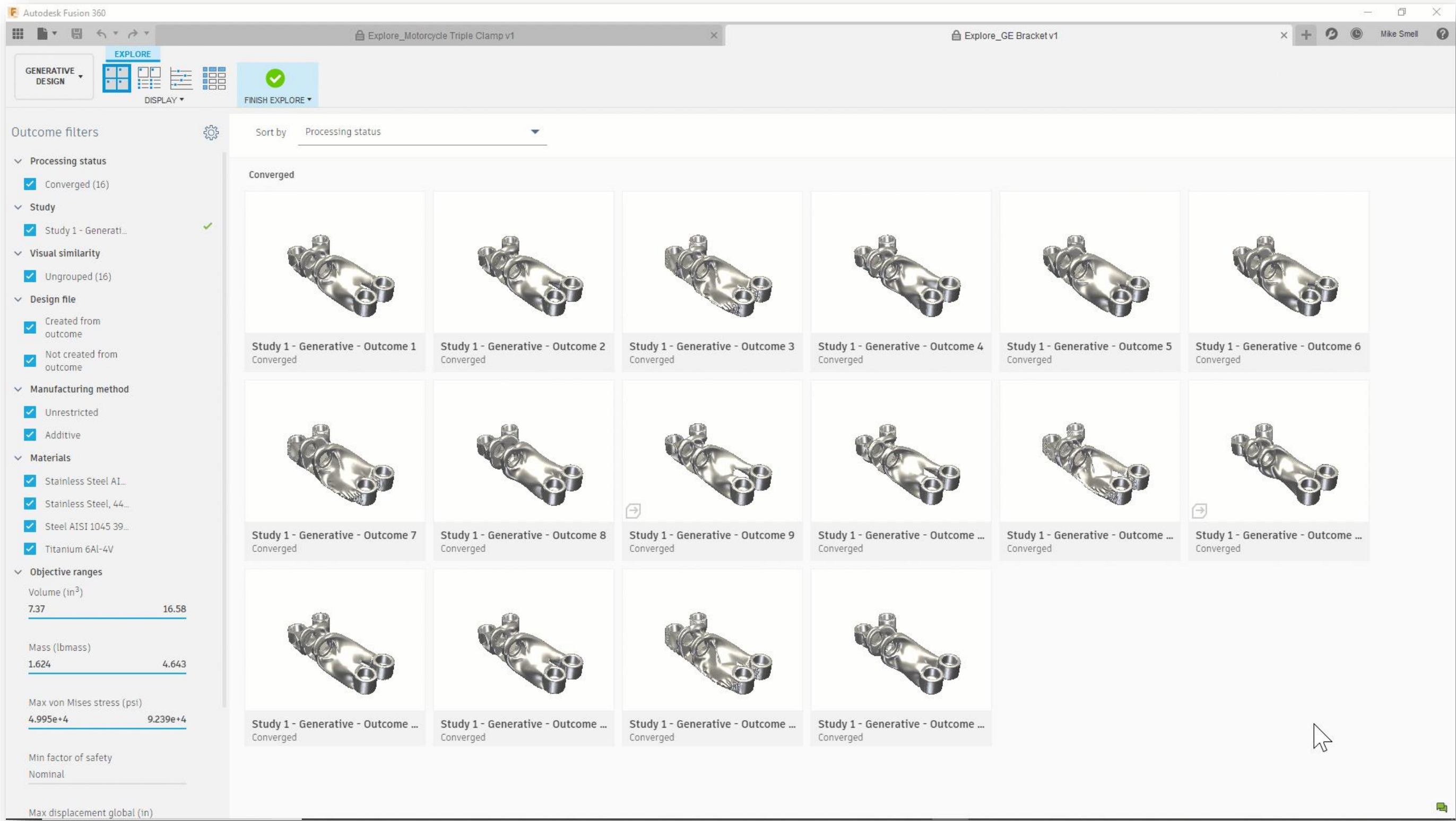
March 2020

Improved Cloud Credit Management Experience



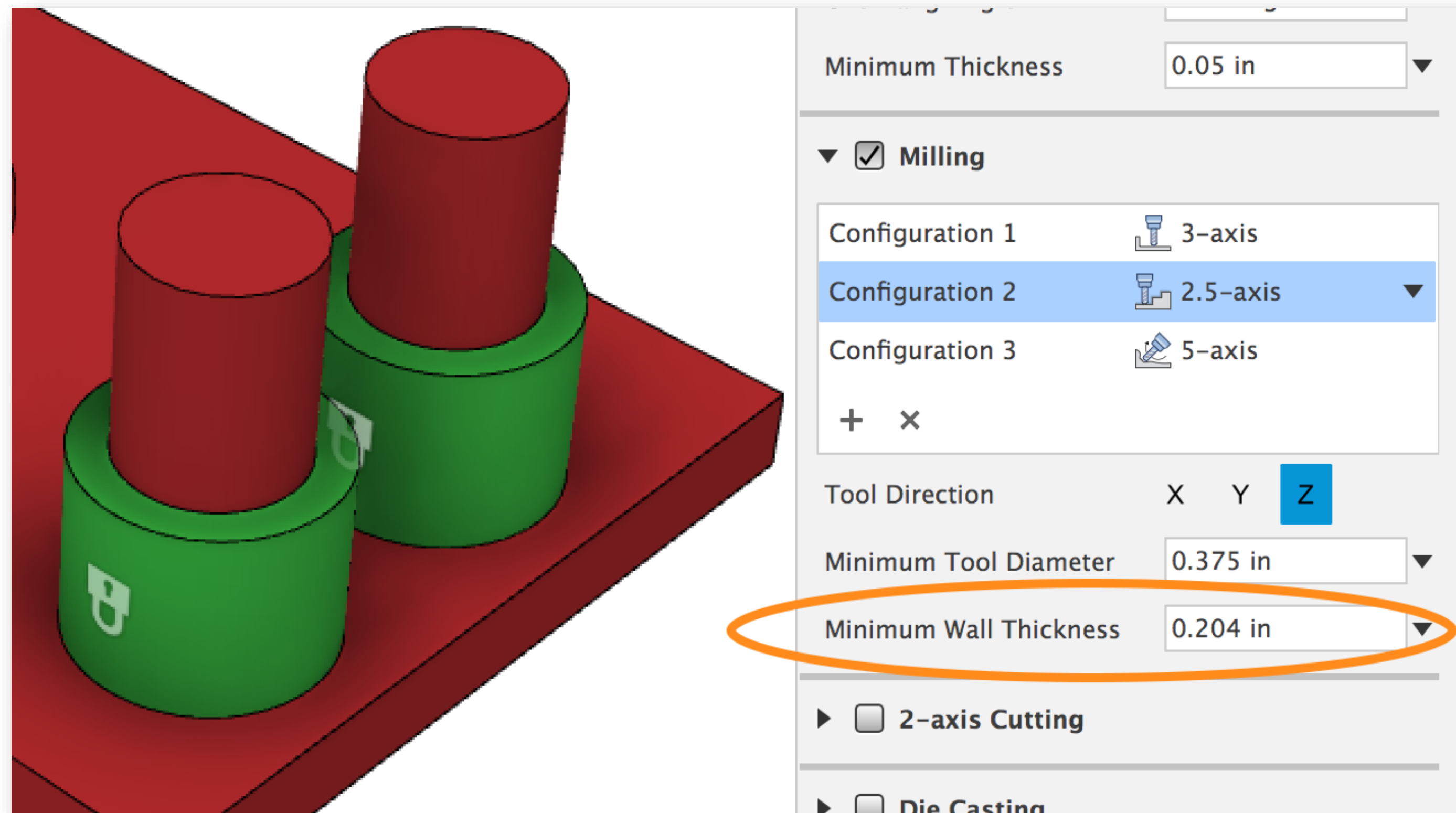
March 2020

Explore Performance and Persistence



April 2020

2.5 Axis Milling Minimum Wall Thickness



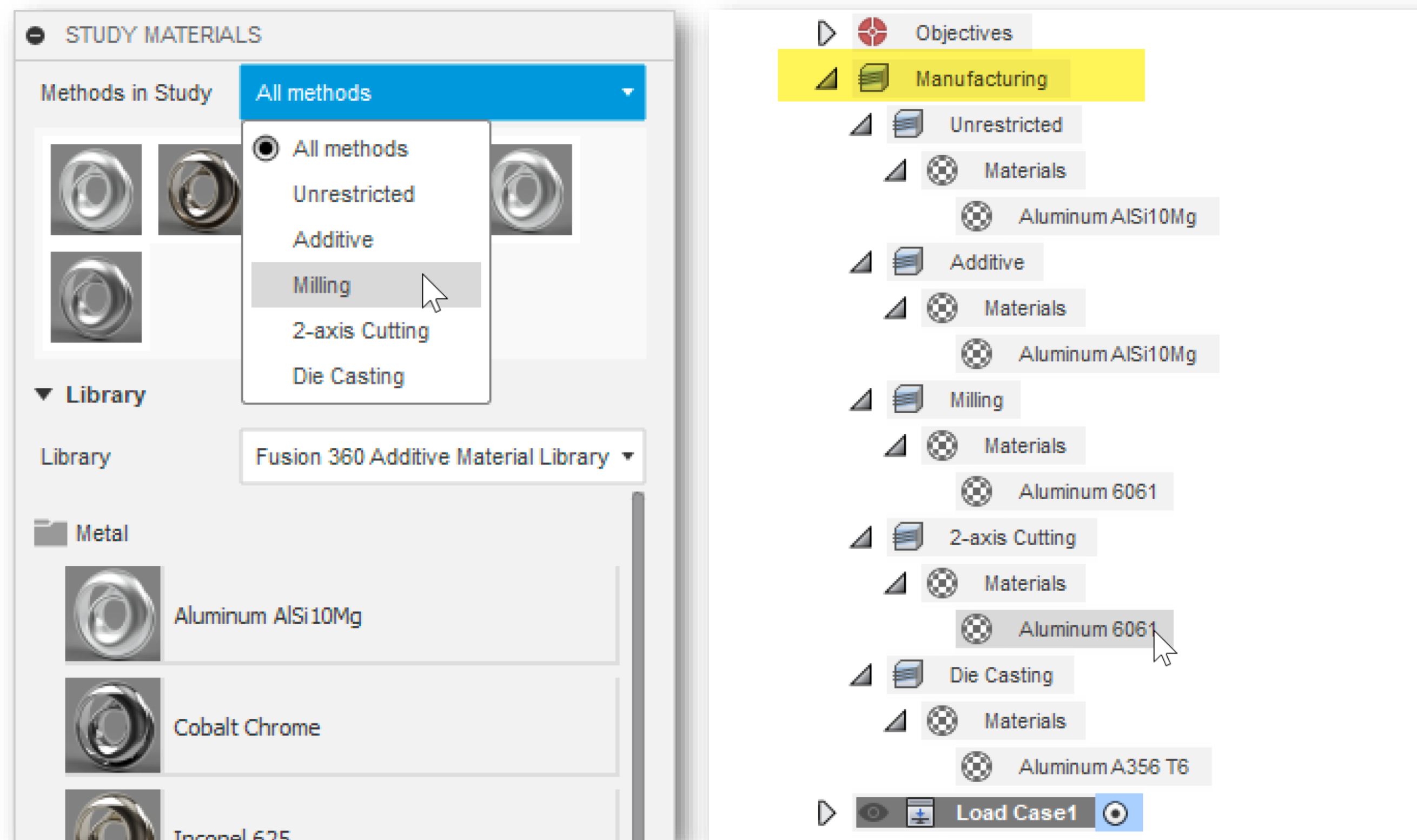
April 2020

Visual Similarity and Cost Estimations for Legacy Documents



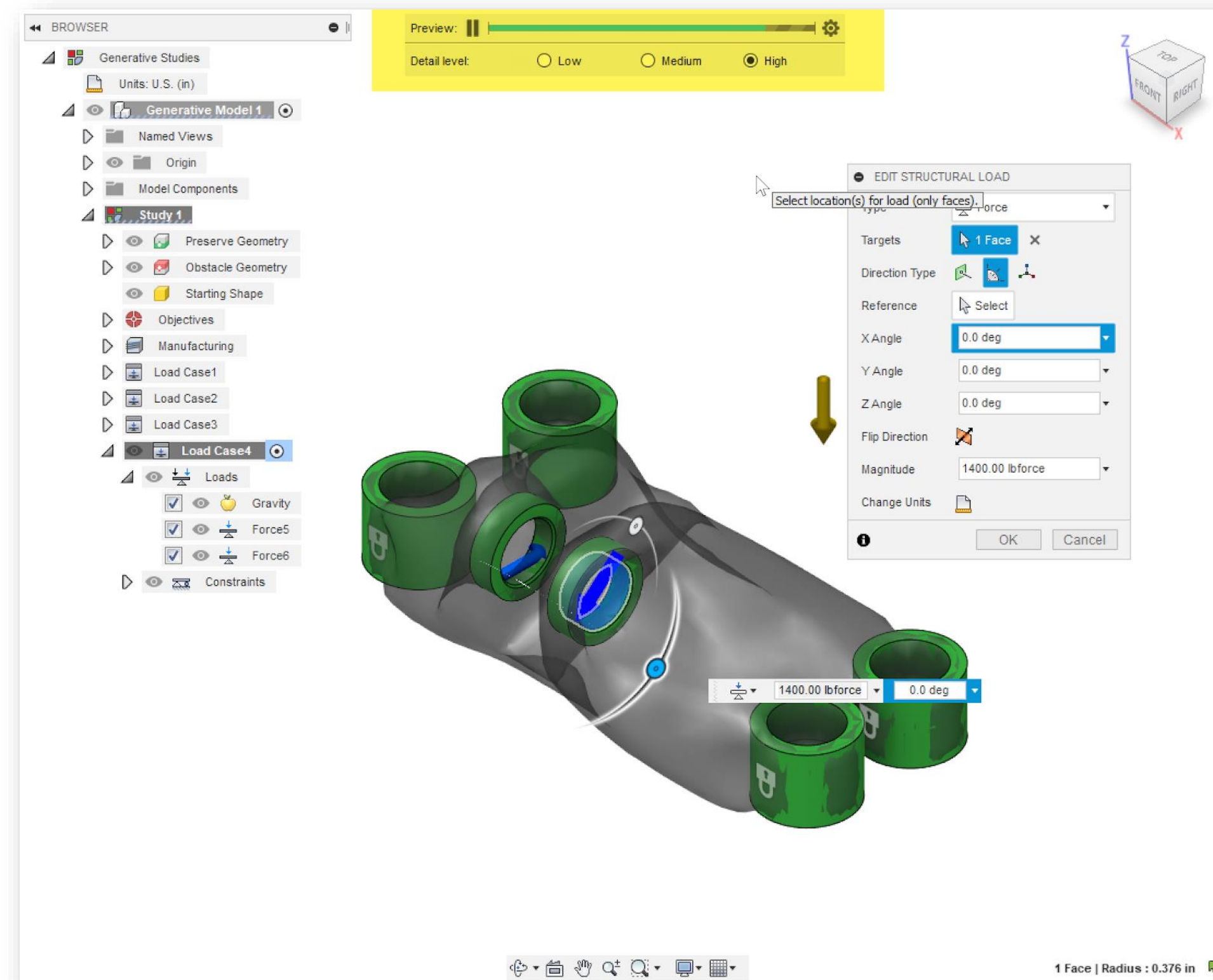
May 2020

Material Definition per Manufacturing Process



May 2020

Improved Previewer Experience – Automatic Restarts and More Control



May 2020

Custom Controls for Outcome Filters and Properties in Explore

Outcome filters

> Processing status

> Study

> Visual similarity

> Manufacturing method

> Materials

> Objective ranges

Volume (in³)

8.5420.47

Mass (lbmass)

1.0345.454

Max von Mises stress (psi)

1.051e+49.98e+4

Min factor of safety

1.282.46

Max displacement global (in)

00.11

Estimated manufacturing cost (USD)

3512,400

Cost estimates powered by **āPriori**

Sort byProcessing status

Visibility settings

AllMike's Custom View

Outcome filtersProperties

Processing status

Study

Visual similarity

Labels

Design file

Tech-Preview

Manufacturing method

Materials

Objective ranges

Volume

Mass

Max von Mises stress

Min factor of safety

Max displacement global

Max displacement X

Max displacement Y

Max displacement Z

First mode frequency

Estimated manufacturing cost

3D model of a mechanical part

You are viewing the Design Preview

3D model of a mechanical part

Iterations1015

Study 1 - Generati... Outcome 6

Iteration 15 (final)

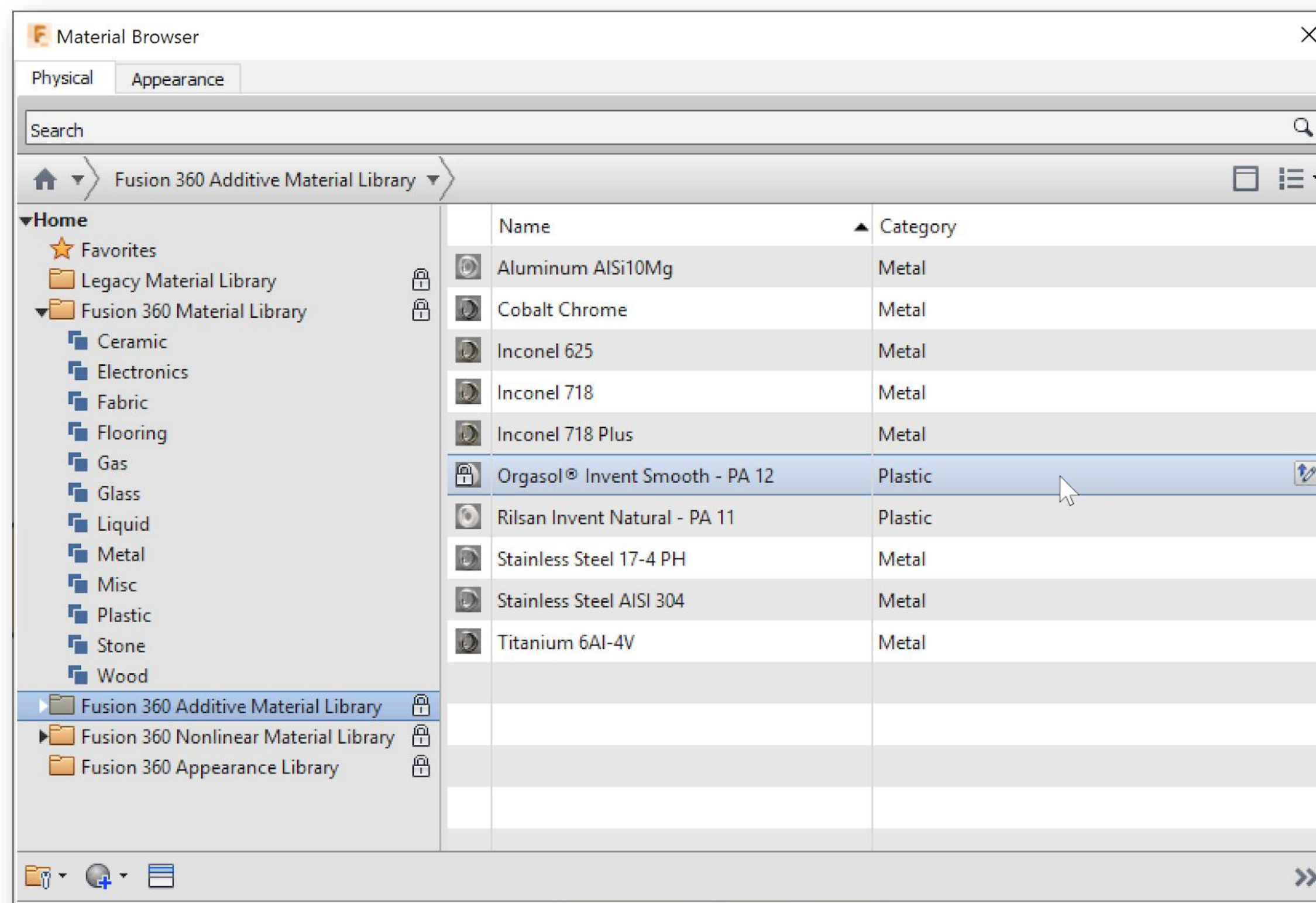
Properties

Status	Converged
Material	Aluminum 6061
Manufacturing method	2.5 axis milling
Production volume (pcs.)	500
Estimated manufacturing cost	
Range (USD)	37 - 89
Median (USD)	50
Volume (in ³)	12.39
Mass (lbmass)	1.208
Max von Mises stress (psi)	1.994e+4
Min factor of safety	2
Max displacement global (in)	0.04

Cost estimates powered by **āPriori**

May 2020

Support for Orgasol® Invent Smooth – PA 12



June 2020

Individual Access Extension – Monthly and Annual

FUSION 360 – GENERATIVE DESIGN EXTENSION

Design without limits

Discover ideas beyond the reach of human capacity. Explore unlimited ideas and optimize designs for specific materials and manufacturing techniques with the generative design extension.

SUBSCRIBE



June 2020

Generative Design Learning Path

Generative design

The generative design path includes a series of five courses that guide you through the generative workflow, key features, and concepts. To get started with Fusion 360 Generative Design, we recommend that you complete the five courses in sequence.

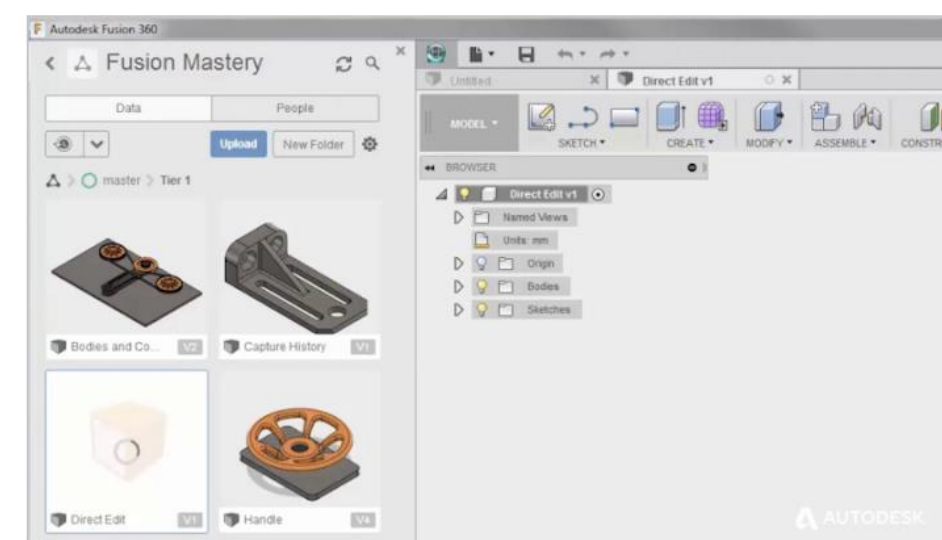


Fusion 360 Generative Design (1 of 5)

- 3 lessons
- Beginner
- Lecture

Fusion 360 Generative Design enables you to specify design objectives and generate a wide set of designs that meet the requirements. Next, using a variety of exploration tools, you can select the optimal design for manufacture.

→ Start learning



Fusion 360 basics for Generative Design (2 of 5)

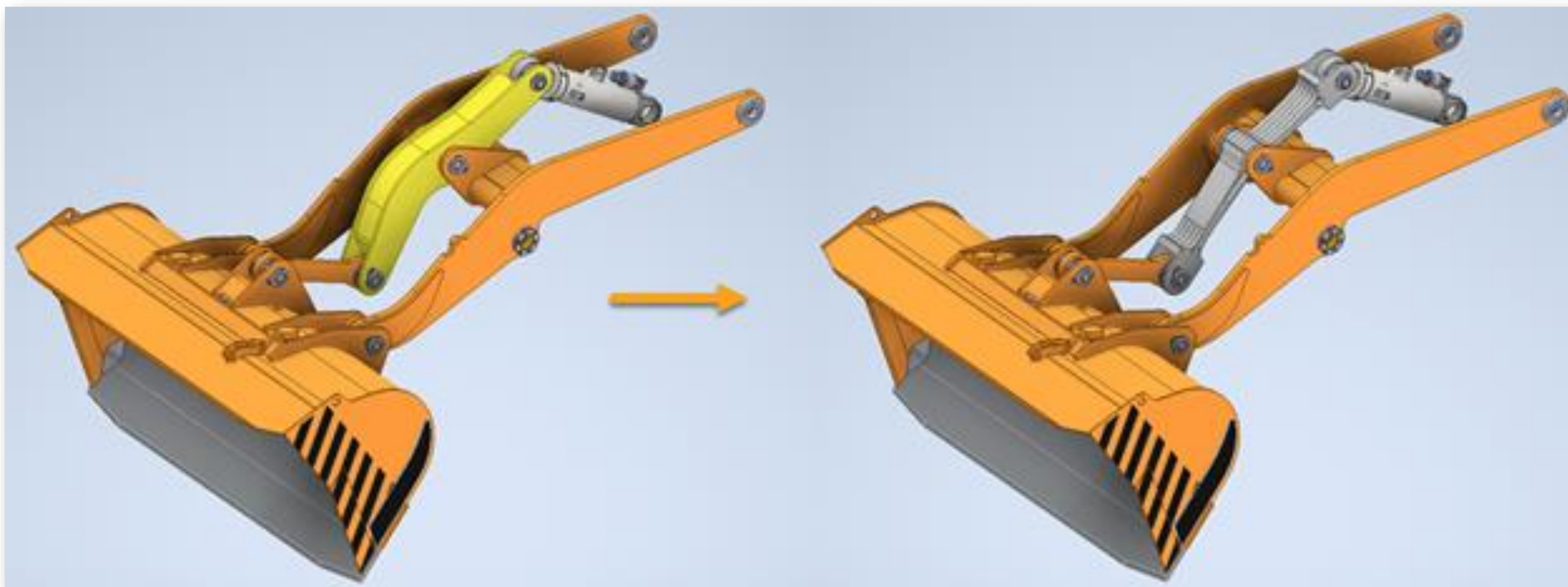
- 3 lessons
- Beginner
- Lecture

Fusion 360 is a cloud-based CAD/CAM/CAE tool for collaborative product development. Tour the Fusion 360 platform and the user interface. Learn how to open designs created in other CAD systems.

→ Start learning

June 2020

Inventor to Fusion 360 Generative Design Workflow Tutorial



June 2020

Fully Burdened Cost Calculations and Improved Library Experience

Objective ranges

Volume (in³)

8.6 20.47

Mass (lbmass)

1.034 5.454

Max von Mises stress (psi)

10,508.3 402,395.8

Min factor of safety

0.32 2.46

Max displacement global (in)

0 0.11


Piece part cost (USD)

4 12,400

Fully burdened cost (USD)

35 12,432

Cost estimates powered by **aPriori**



Study 1 - Outcome 2
Iteration 28 (final)

Properties

Status	Converged
Material	Aluminum 6061
Orientation	X+
Manufacturing method	Additive
Visual similarity	Group 16
Production volume (pcs.)	500

Piece part cost

Range (USD)	172 - 265
Median (USD)	232









Fully burdened cost

Range (USD)	173 - 267
Median (USD)	233

Volume (in³) 11.68

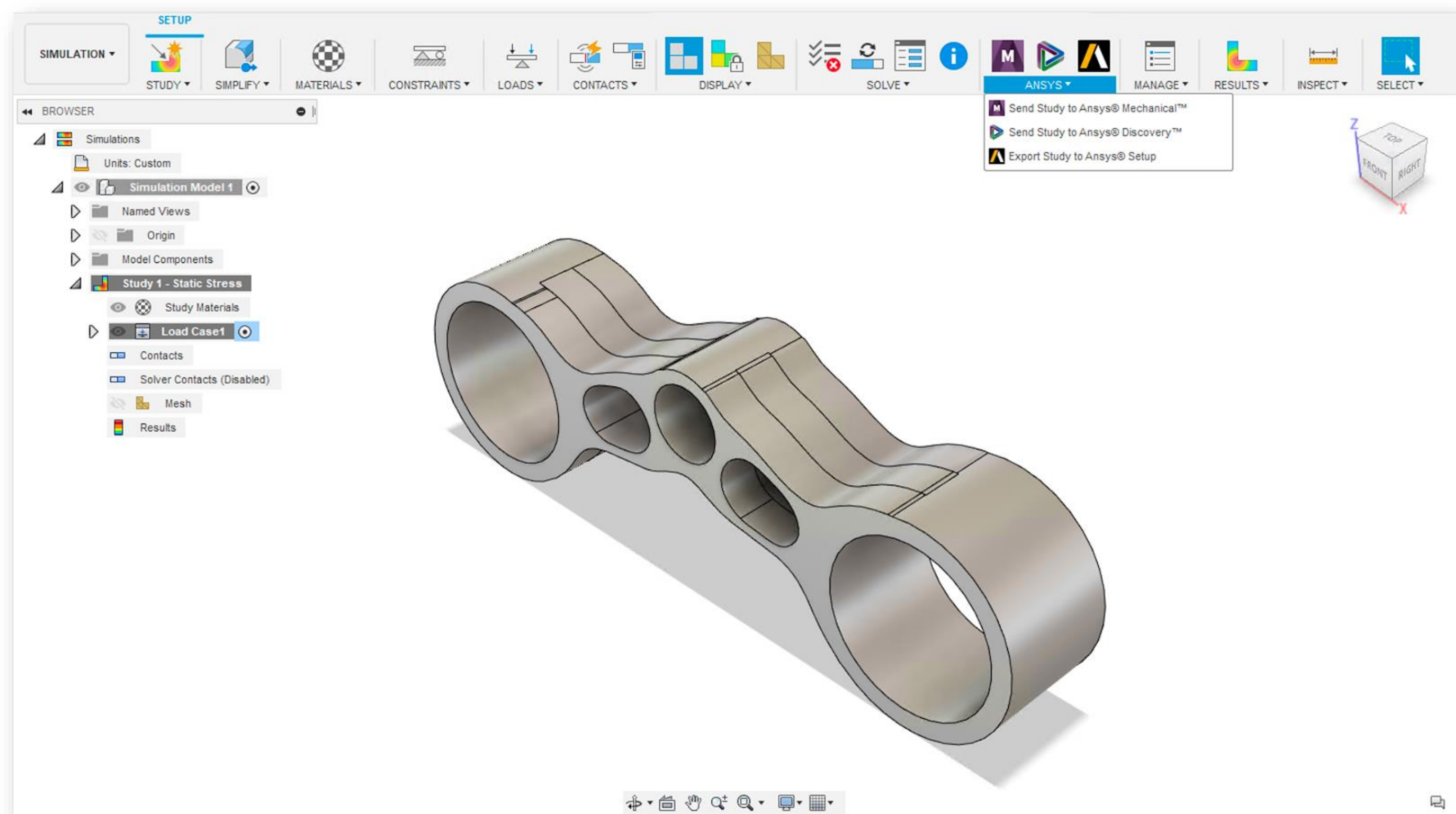
Mass (lbmass) 1.14

Max von Mises stress (psi) 19,942.5

	Inconel 718	
	Inconel 718 Plus	
	Stainless Steel 17-4 PH	
	Aluminum 6061	

June 2020

Support for Ansys Discovery 2020 R2



September 2020

Expanded Manufacturing Controls – Additive Directions and 2 Axis Minimum Wall Thickness

▼ ☒ Additive

Orientation

☒ X+ ☒ Y+ ☒ Z+

X- Y- Z-

Include all six directions ☐

Overhang Angle

Minimum Thickness

▼ ☒ 2-axis Cutting

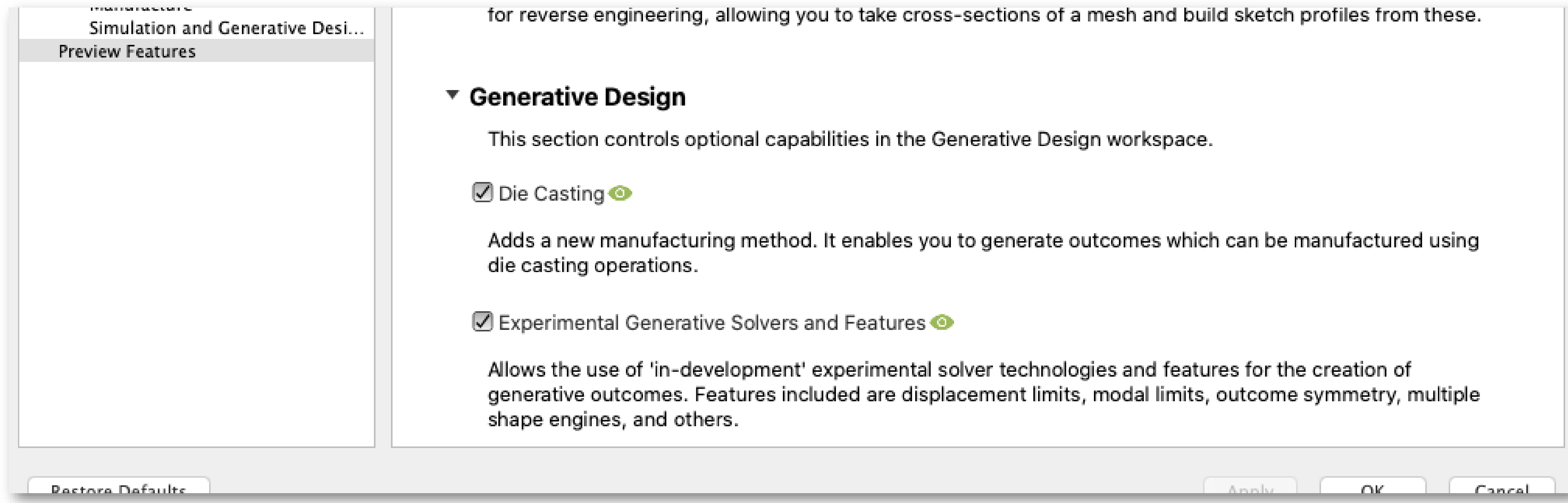
Cutting Direction

X Y ☒ Z

Minimum Wall Thickness

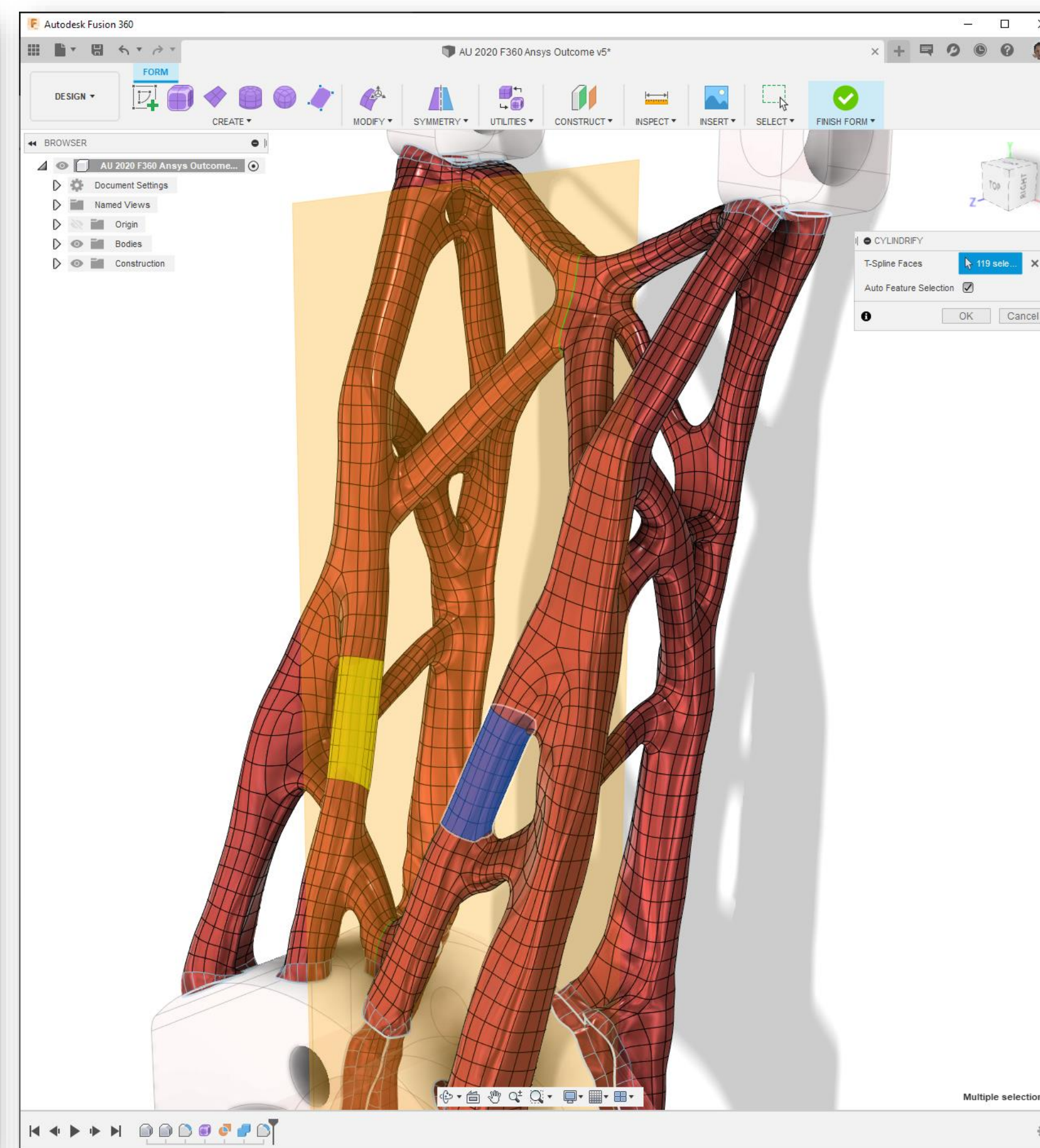
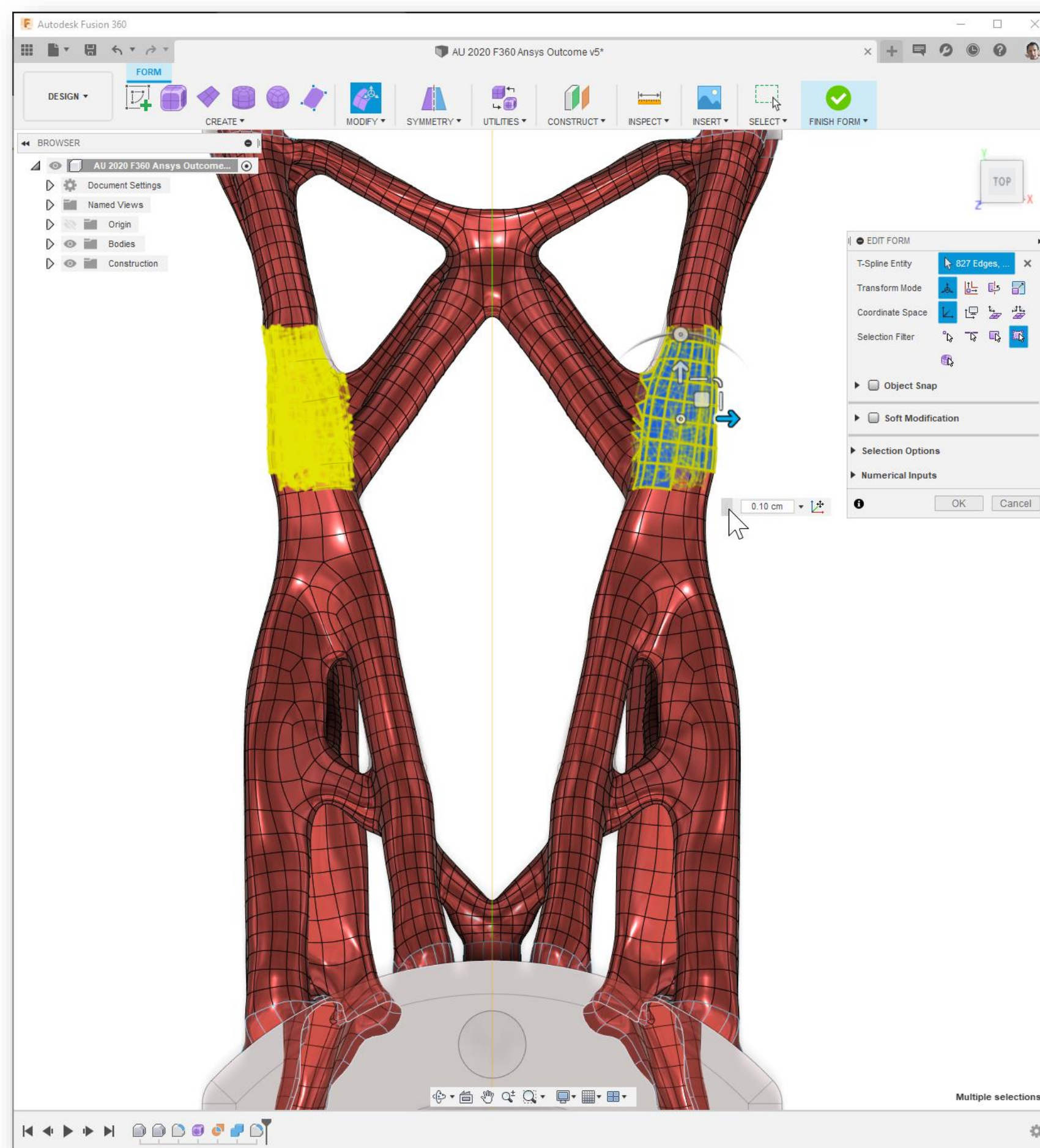
September 2020

Experimental Solver Preview – Displacement, Modal and Buckling Limits, Outcome Symmetry



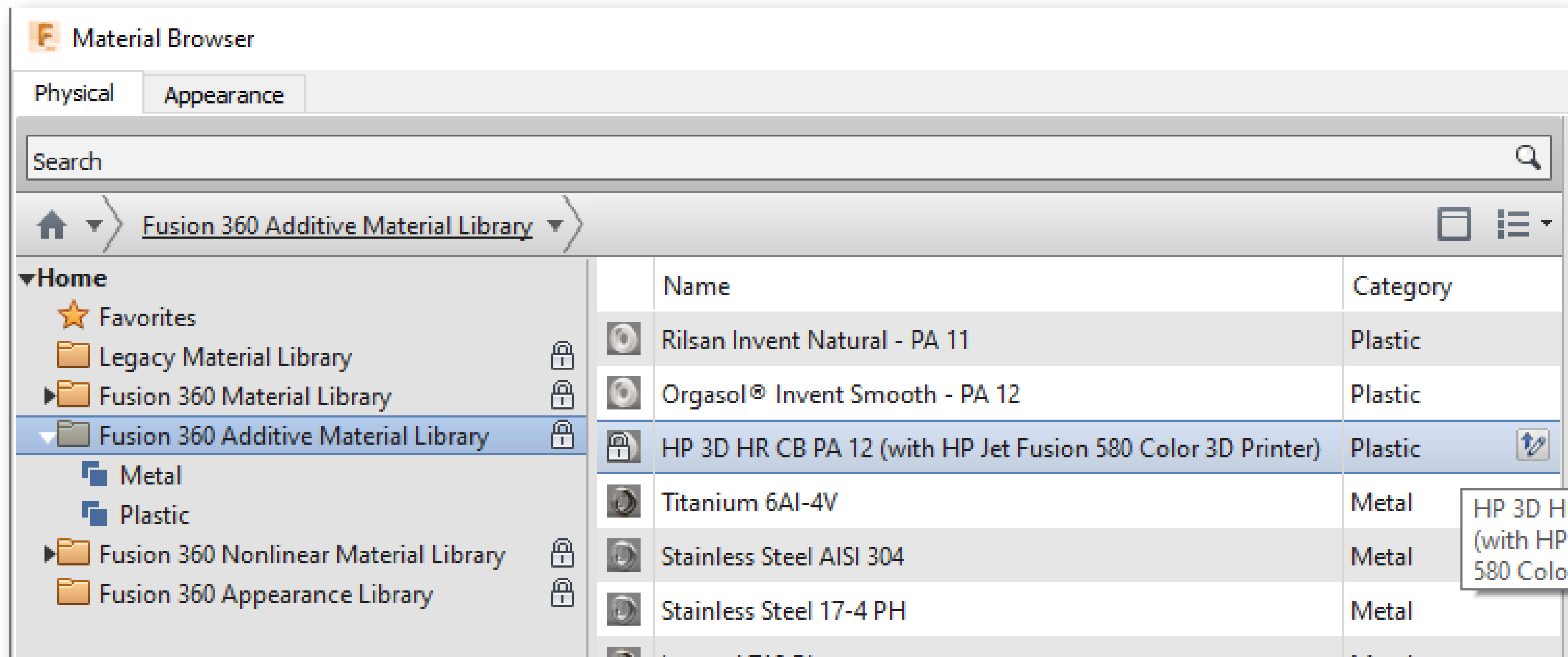
September 2020

Symmetrical Outcome Editability



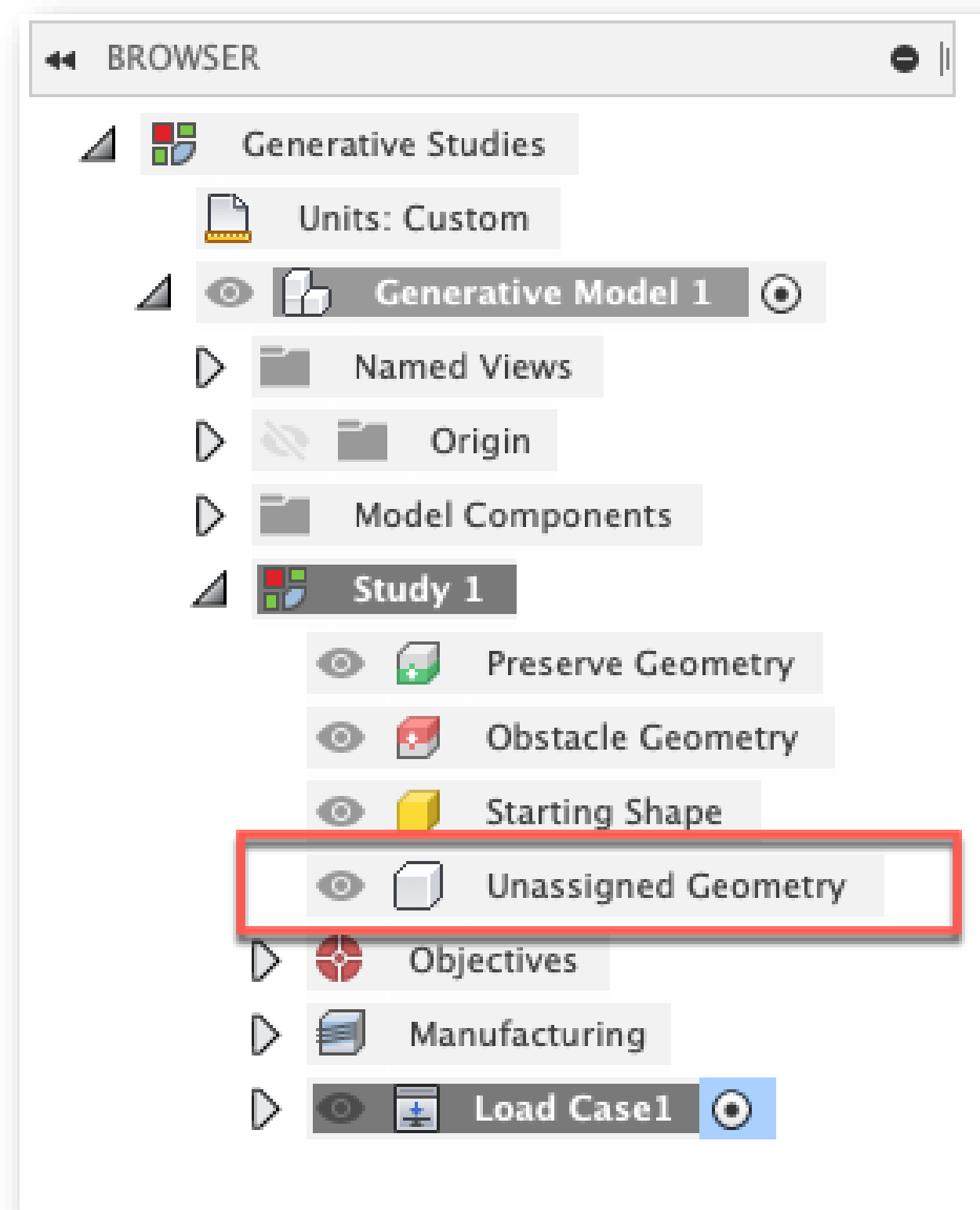
September 2020

Support for HP 3D HR CB PA 12



September 2020

Unassigned Geometry Filter



September 2020

Individual Unlimited Access Extension Trial

Extensions

Enhance productivity by purchasing access to [Fusion 360 extensions](#). Some extensions add extra functionality to existing workspaces, while other extensions let you perform unlimited actions that would normally require you to spend cloud credits. Purchase access to extensions using [Cloud Credits](#) or a credit card.

Generative Design - Unlimited Access

Access Options

Generative design can discover ideas beyond the reach of human capacity. Use the generative tools to explore unlimited ideas and optimize designs for specific materials, manufacturing techniques, and costs. [Learn more](#)

Unlimited Outcome Generations and Design Creations

Unlimited access enables you to generate design alternatives, called outcomes, and create designs from outcomes, without using cloud credits for each transaction.

Note: You can also generate outcomes, and create designs from outcomes, on a flexible, per-transactions basis using cloud credits. [Learn more](#)

Manufacture

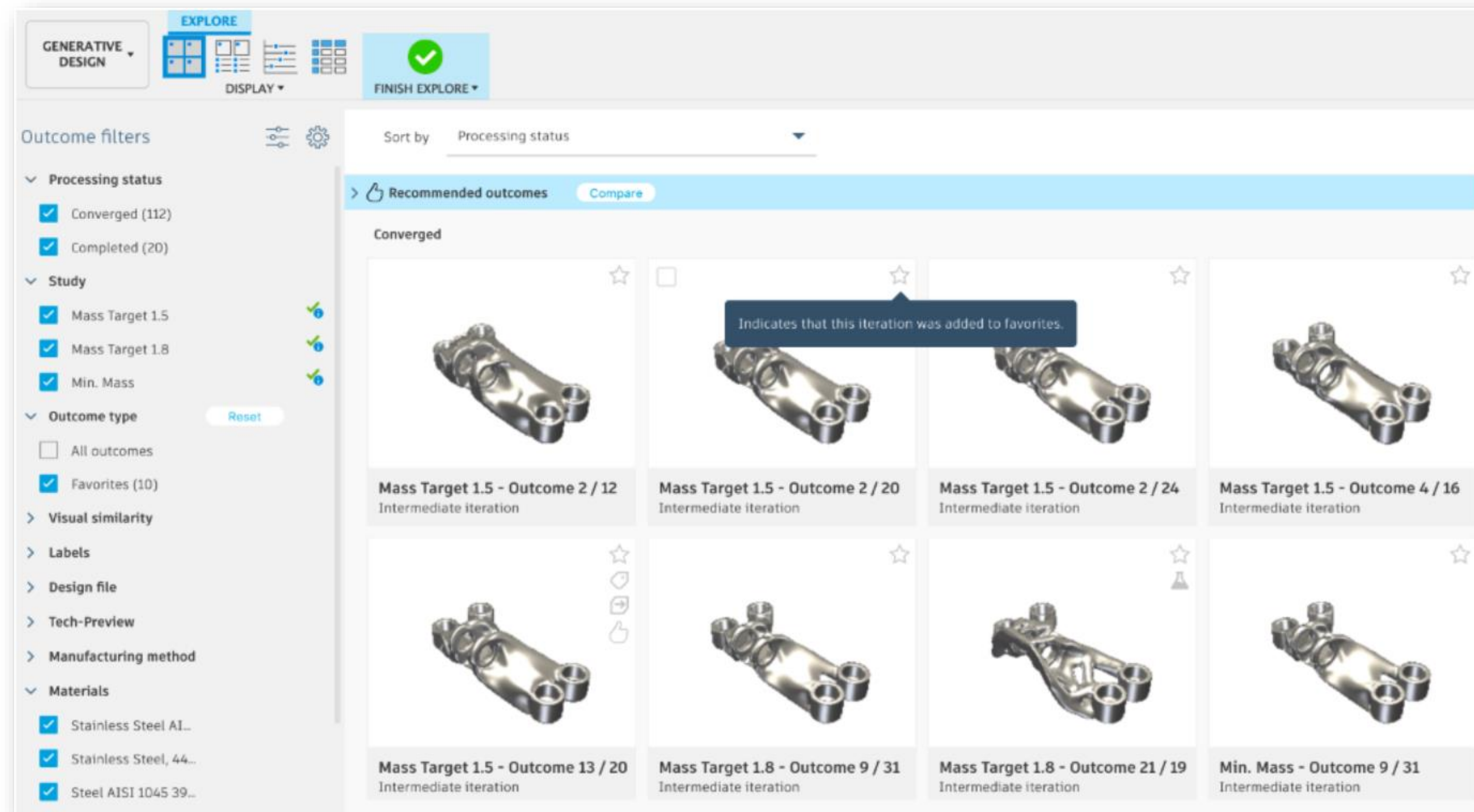
Access Options

Purchase access using credit card

Start 7-day free trial

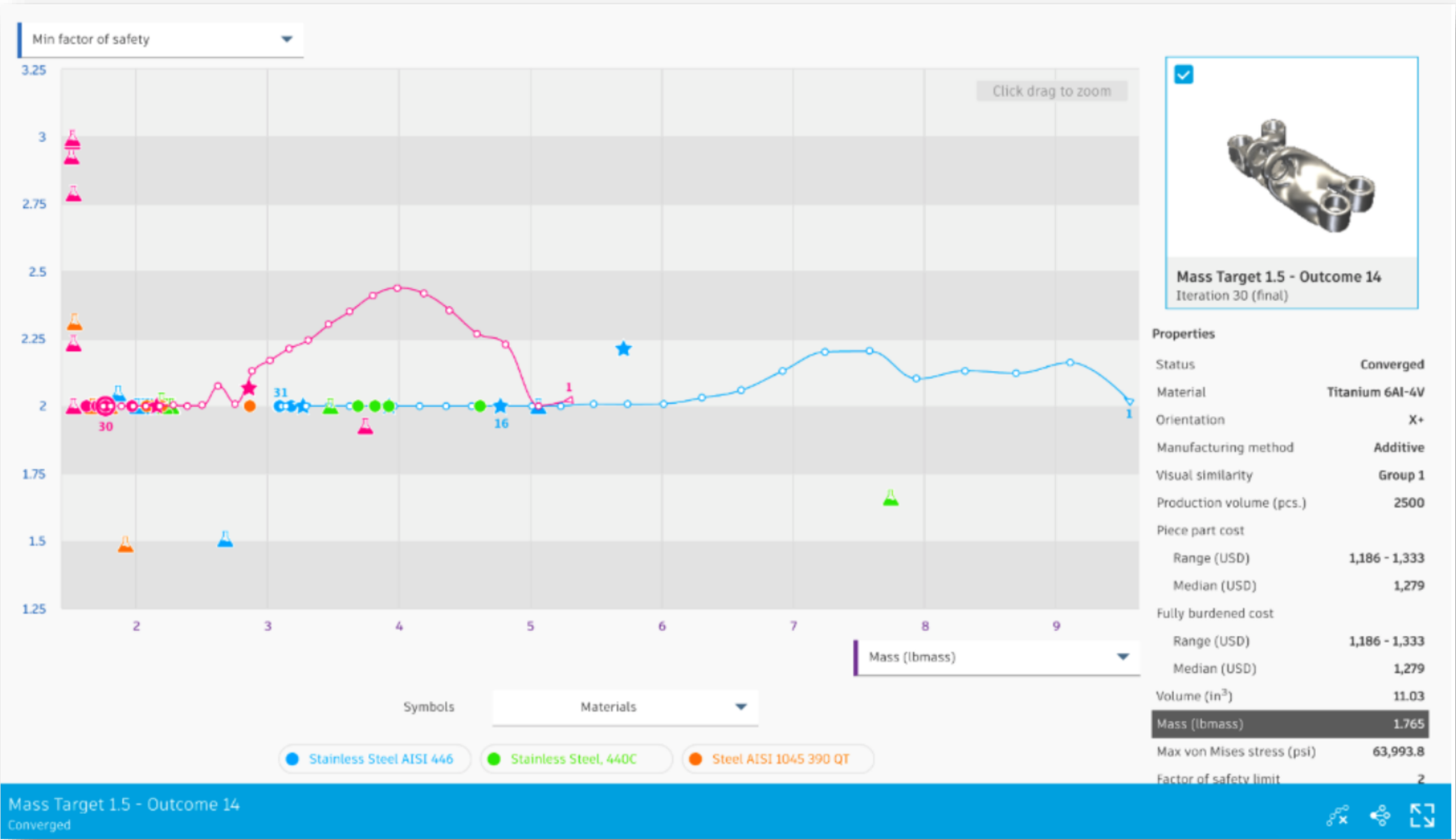
October 2020

Iteration and Outcome Favorites



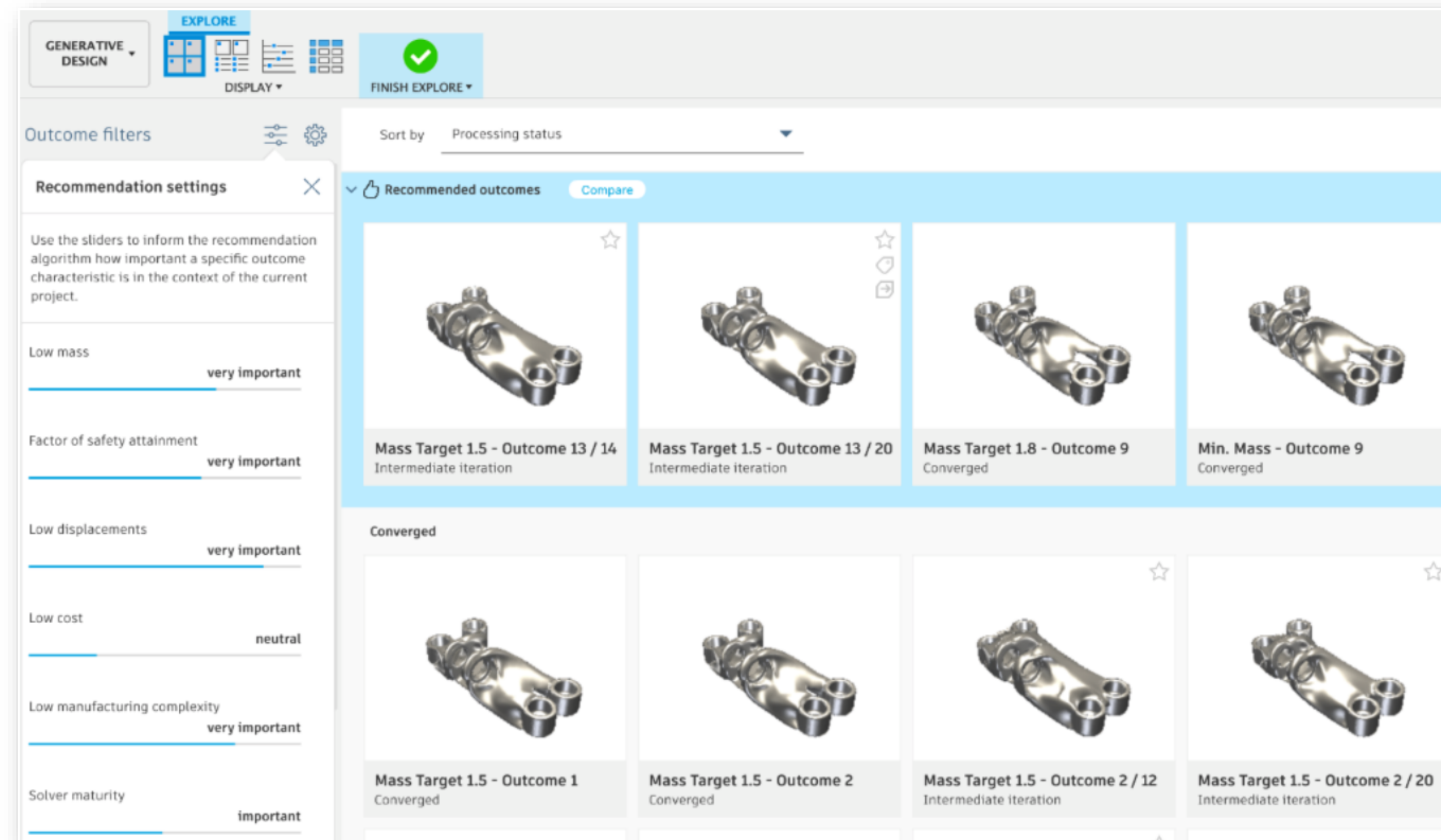
October 2020

Iteration Trend Plotting



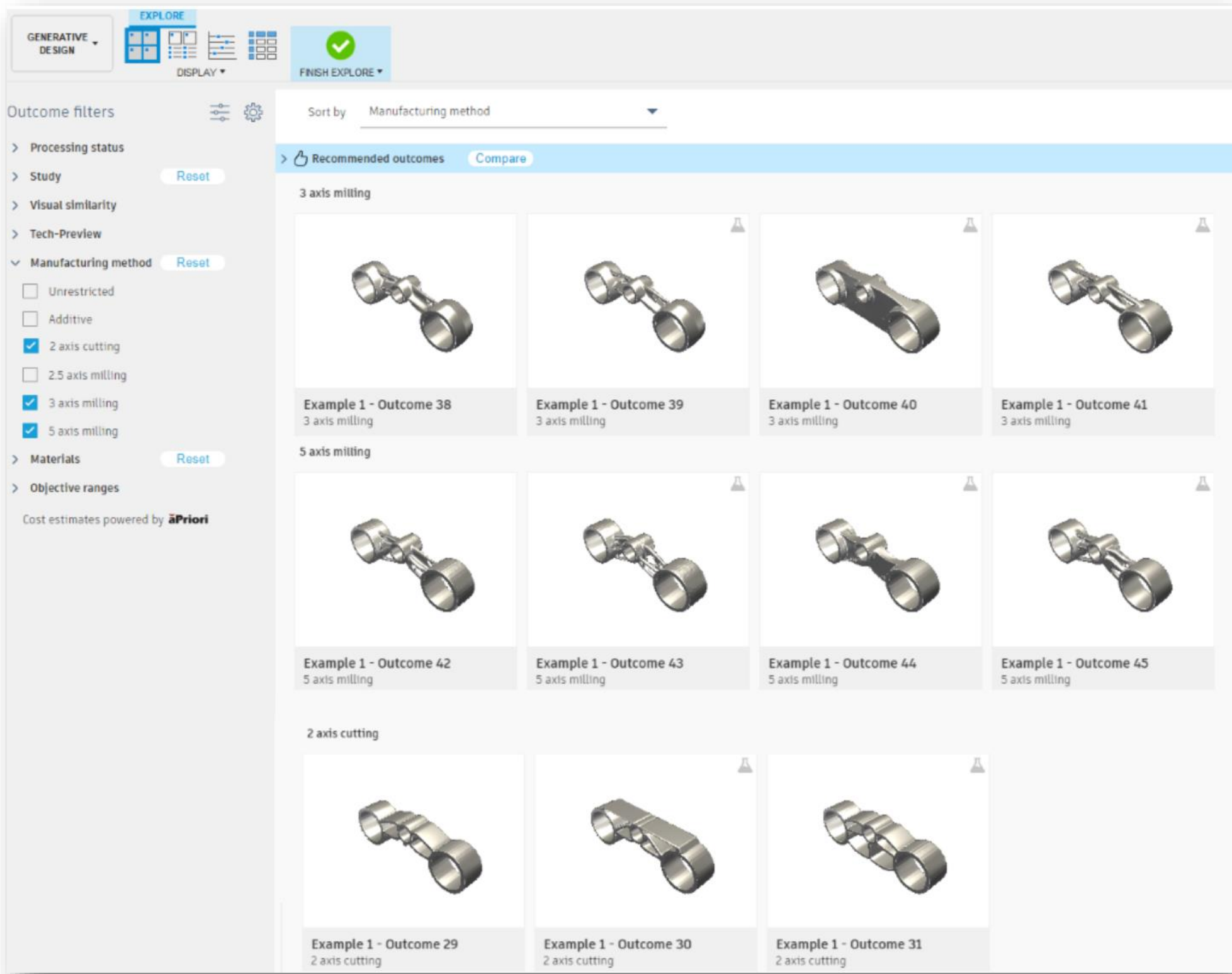
October 2020

Recommended Outcomes

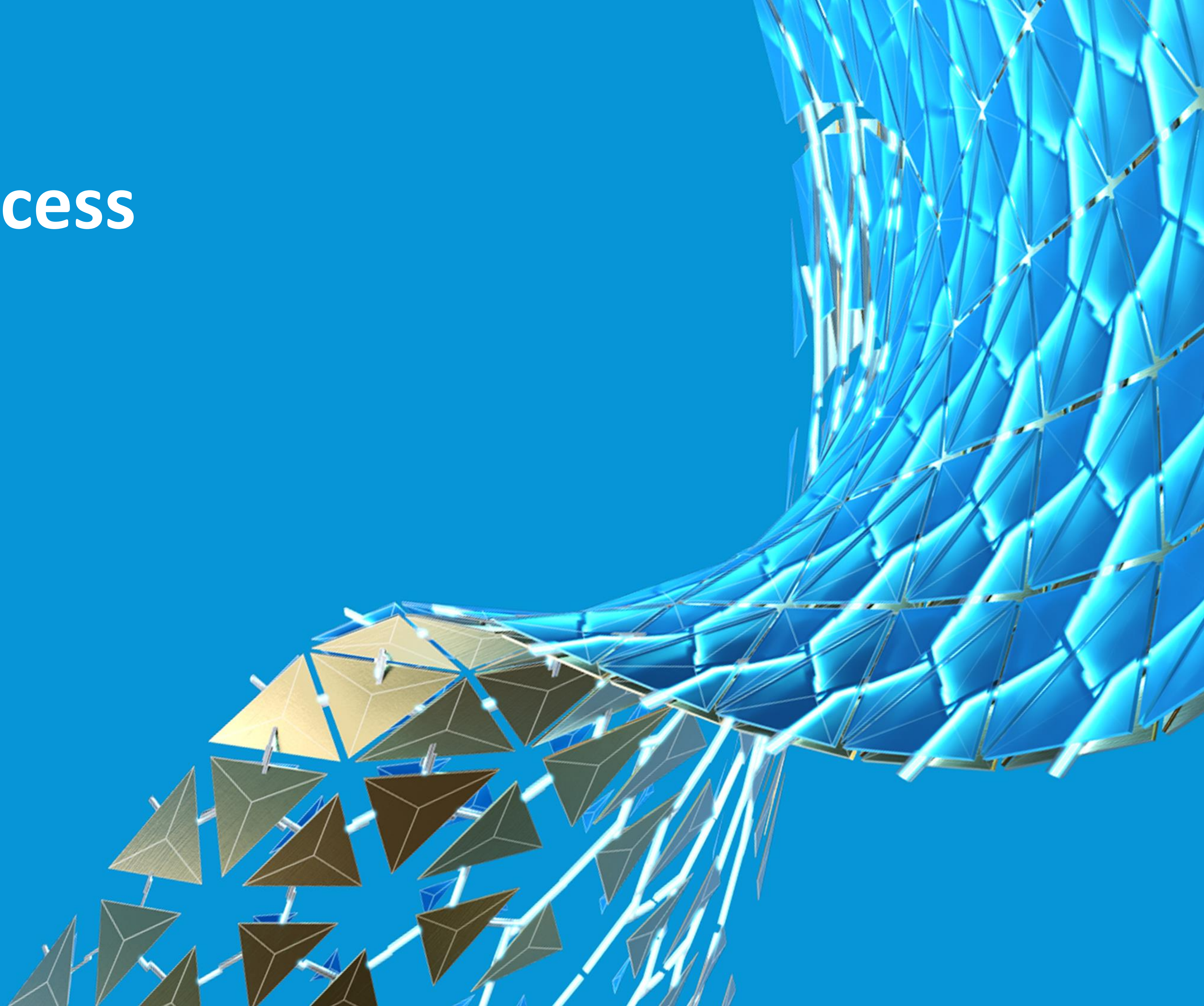


October 2020

Expanding Support for Subtractive MFG Constraints in Experimental Solver – 2, 3, and 5 Axis



Customer Success



GOODYEAR[®]

The logo features the word "GOODYEAR" in a bold, italicized, yellow sans-serif font. A yellow winged foot, a symbol of speed and motion, is positioned over the letter "Y". The foot is depicted in a dynamic, forward-leaning pose with its wings spread. A small registered trademark symbol (®) is located at the end of the word.

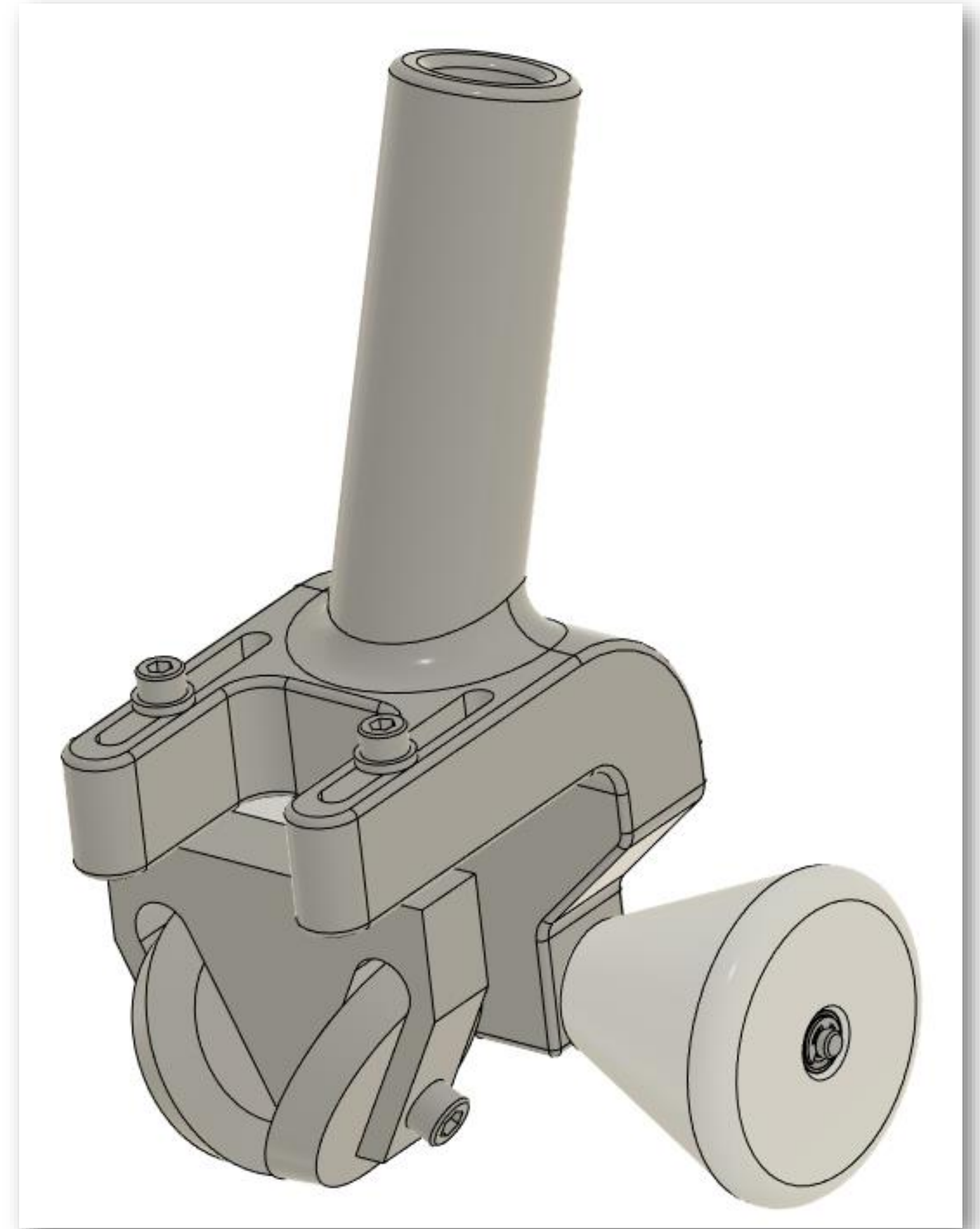


Mark J Montgomery, P.E.

Principal Engineer, Tire Assembly Systems

Production Hand Tool Re-Design

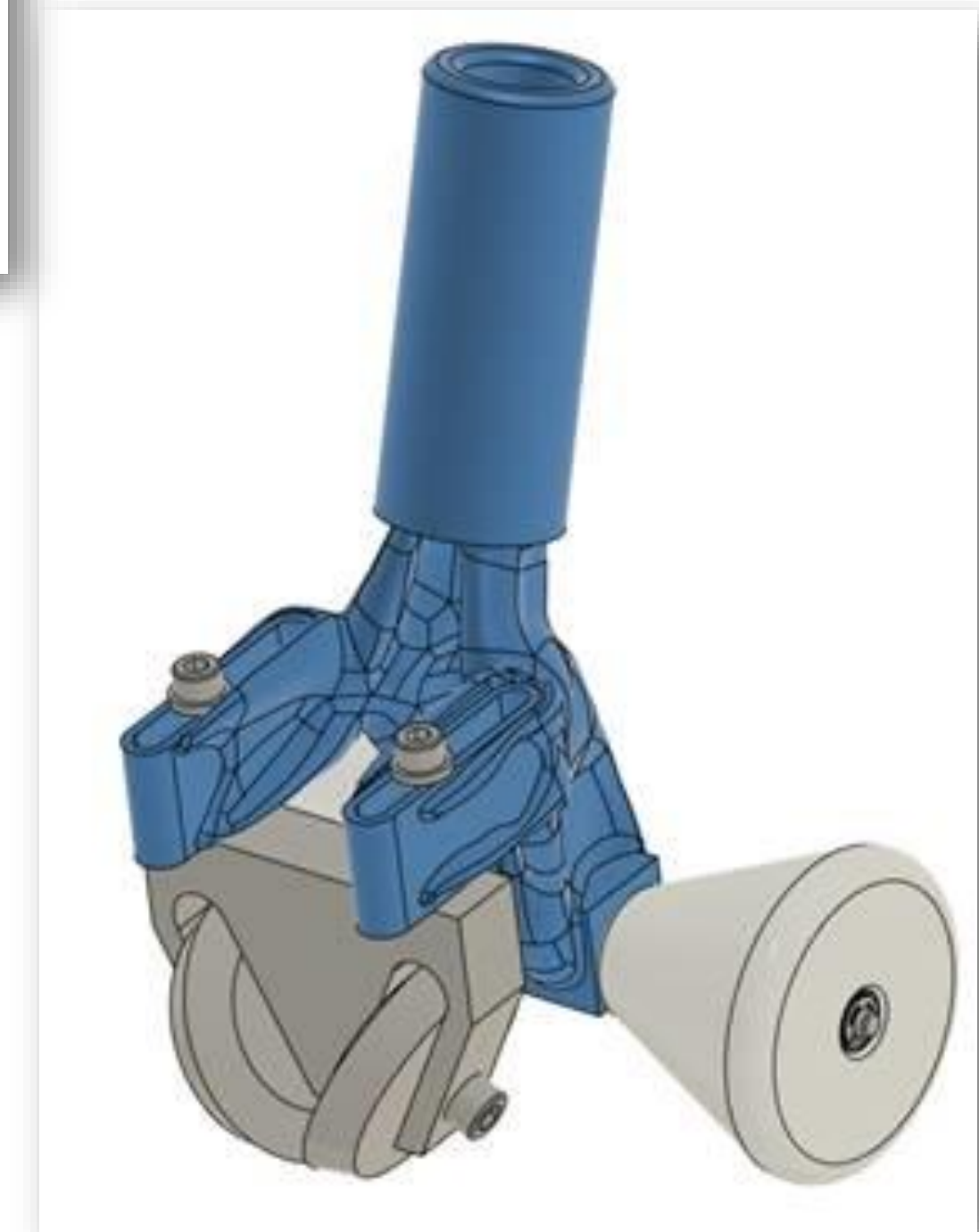
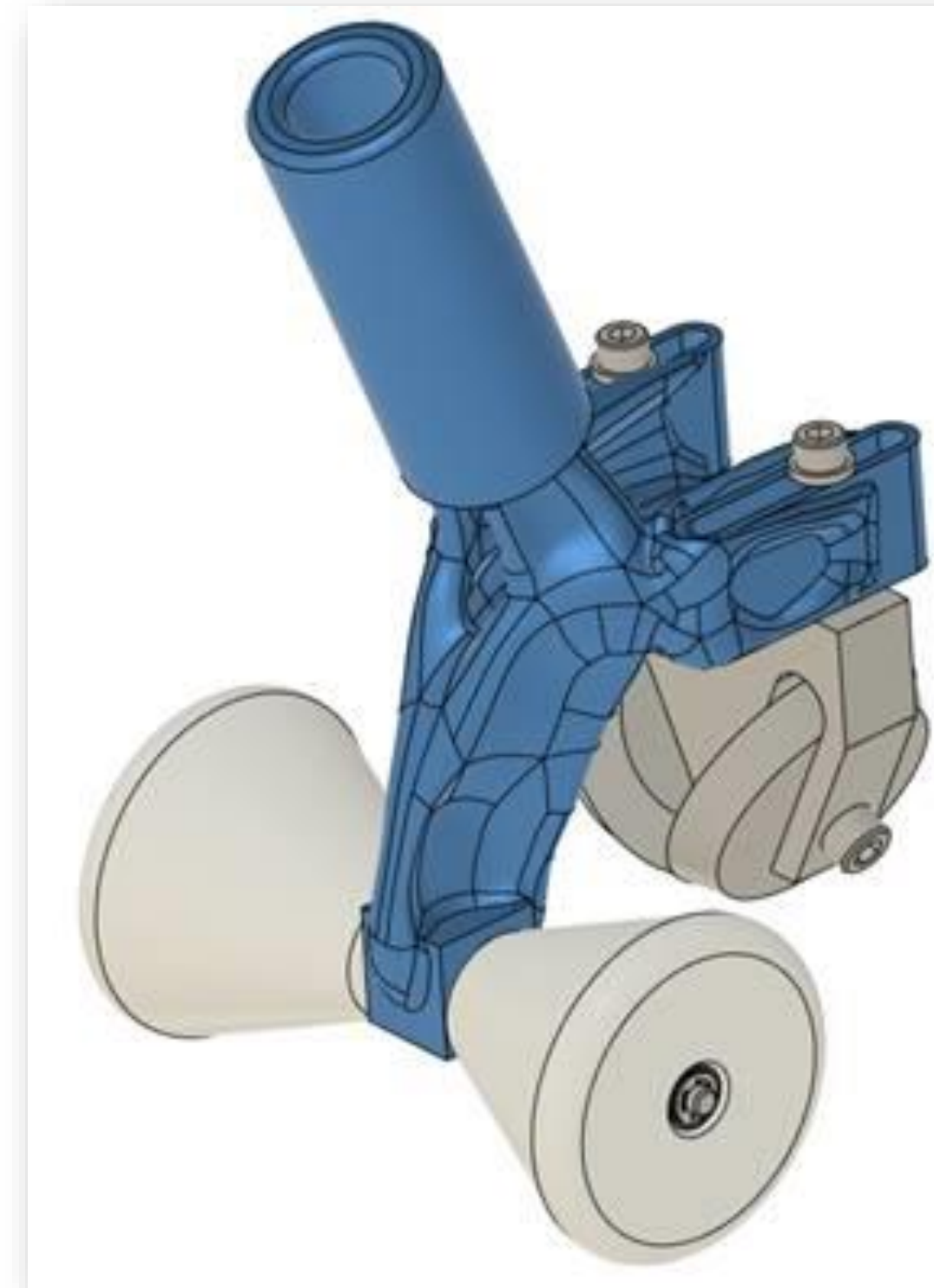
- Interested in “what’s possible” with generative design
- Focused on driving cost reduction and improving performance
- Looking to reduce time to market
- Currently machined from aluminum
- Hundreds of other “similar” tools like this





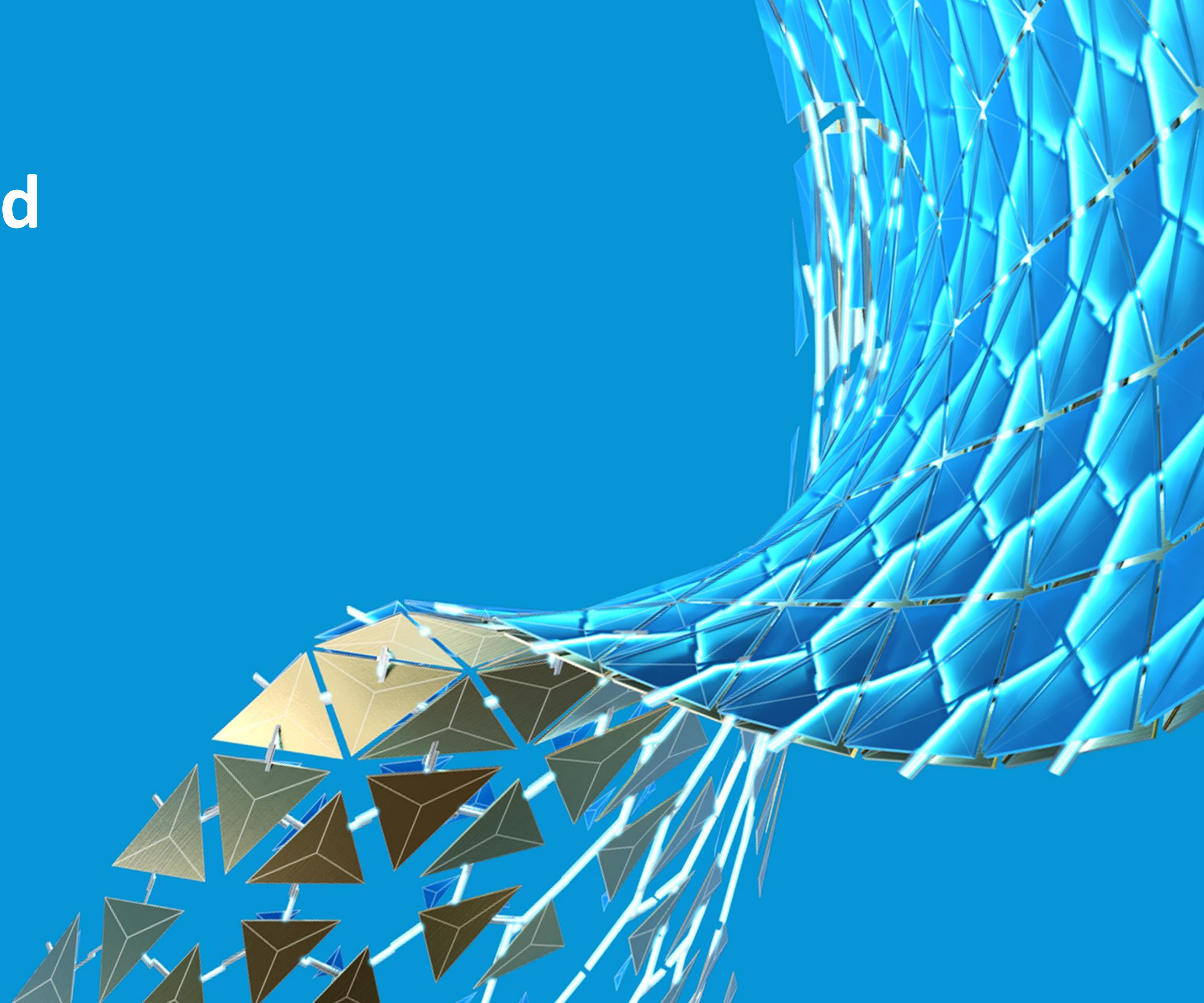
Generative Design Solution

- *Results achieved within 1 hour on the first day of training*
- New Design:
 - Additively manufactured with nylon
 - 1/10th the cost to manufacture
 - 10X faster to produce
 - Met necessary performance requirements

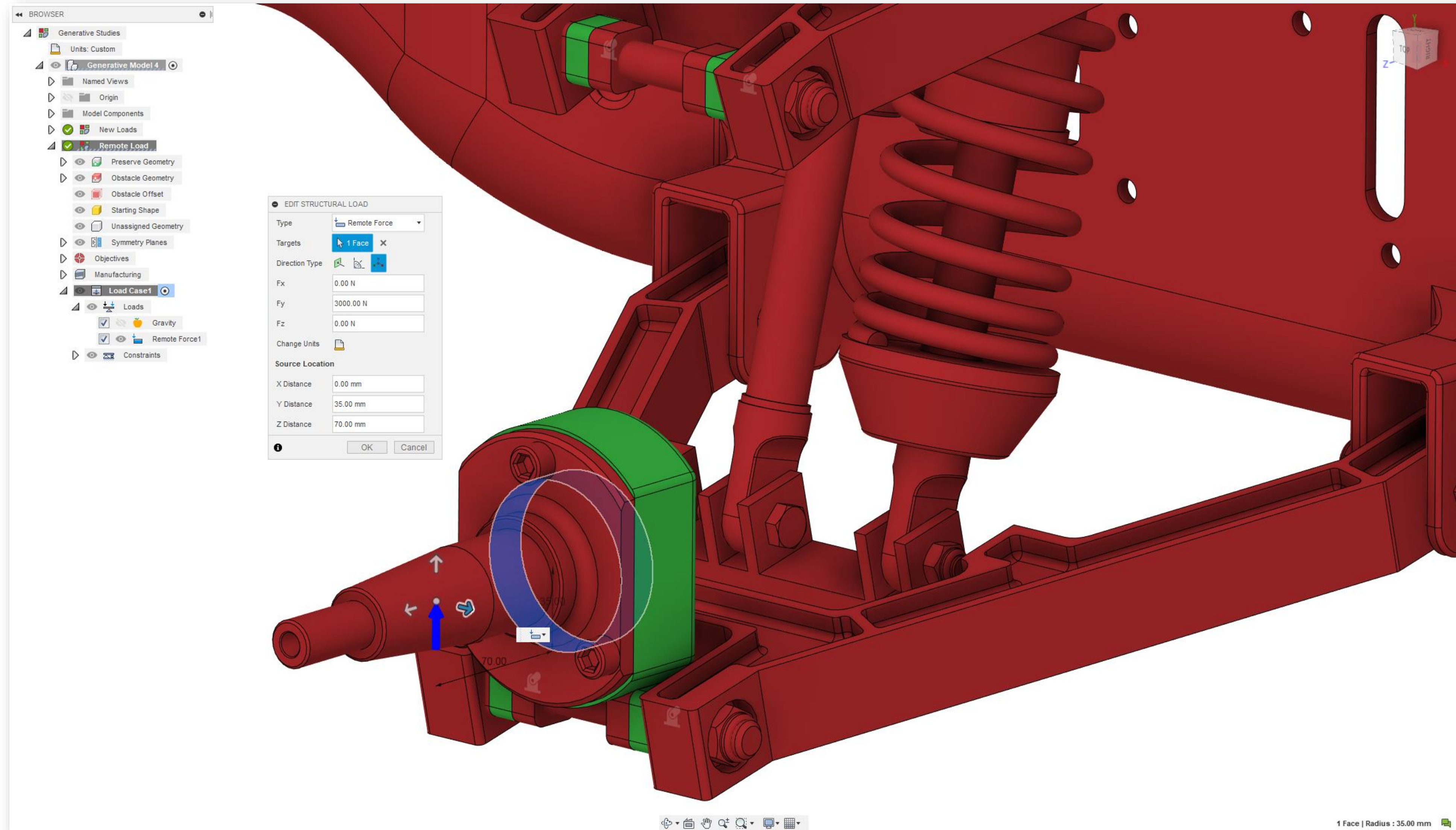


10X cheaper, 10X faster

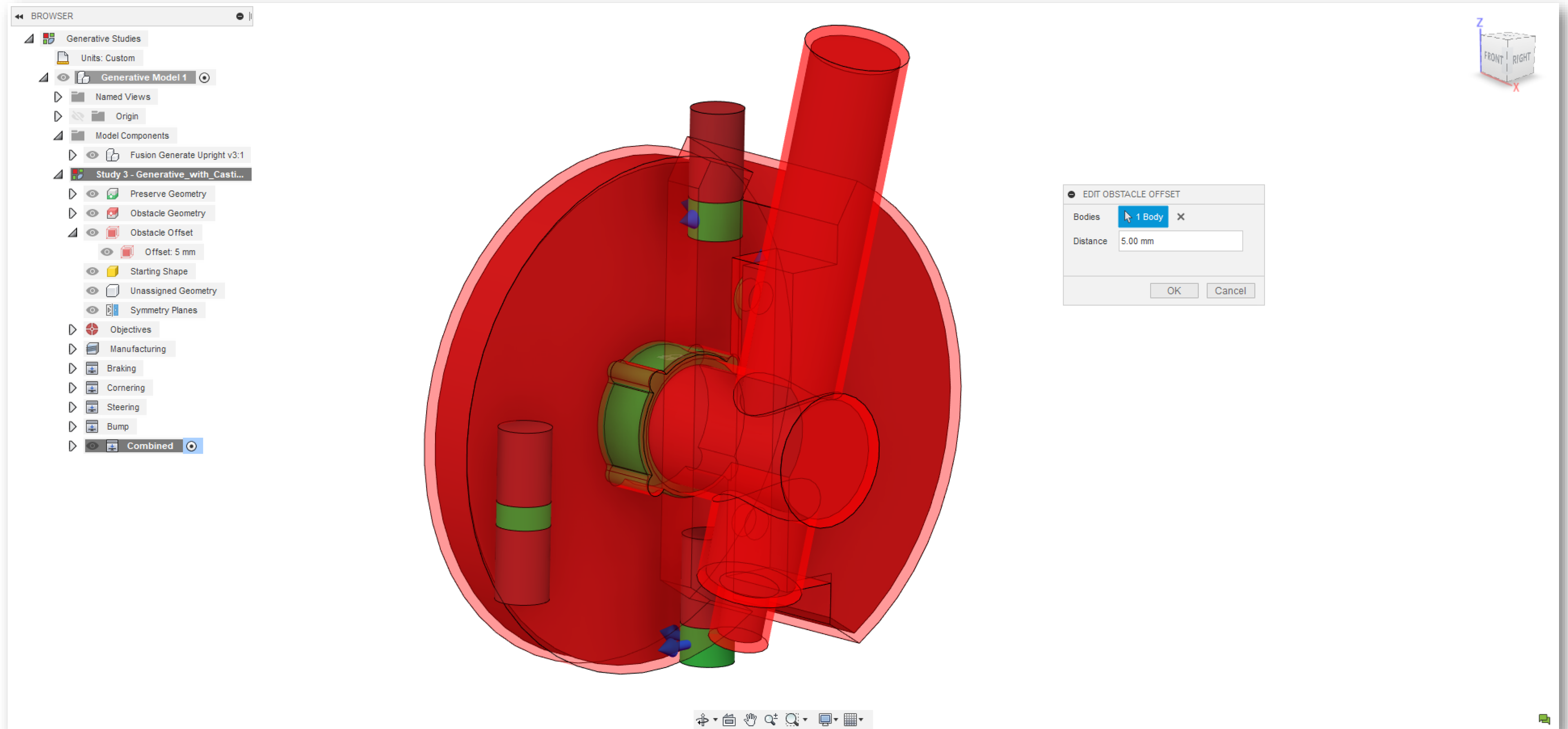
Looking Ahead



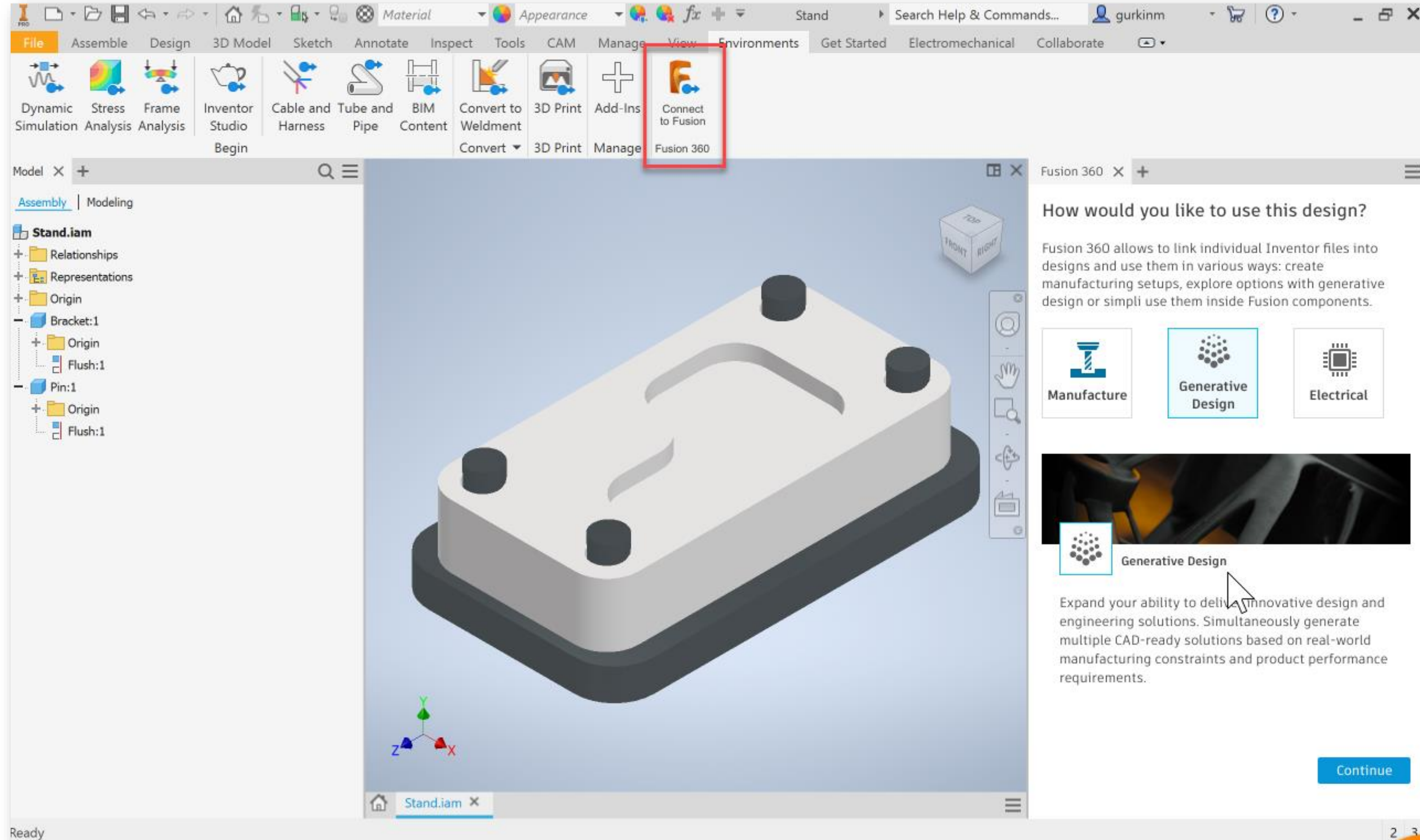
Assembly Context Loads and Constraints



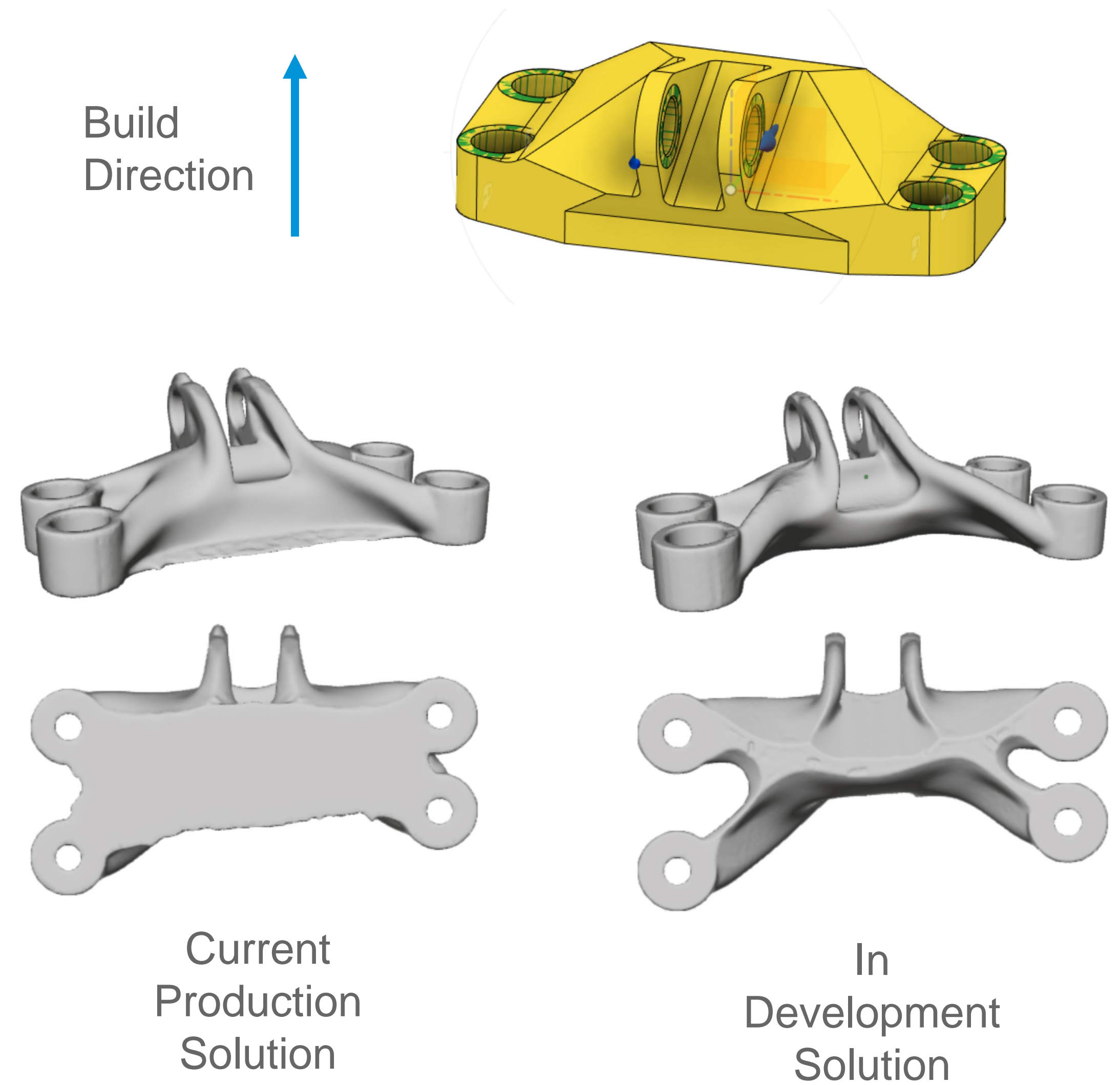
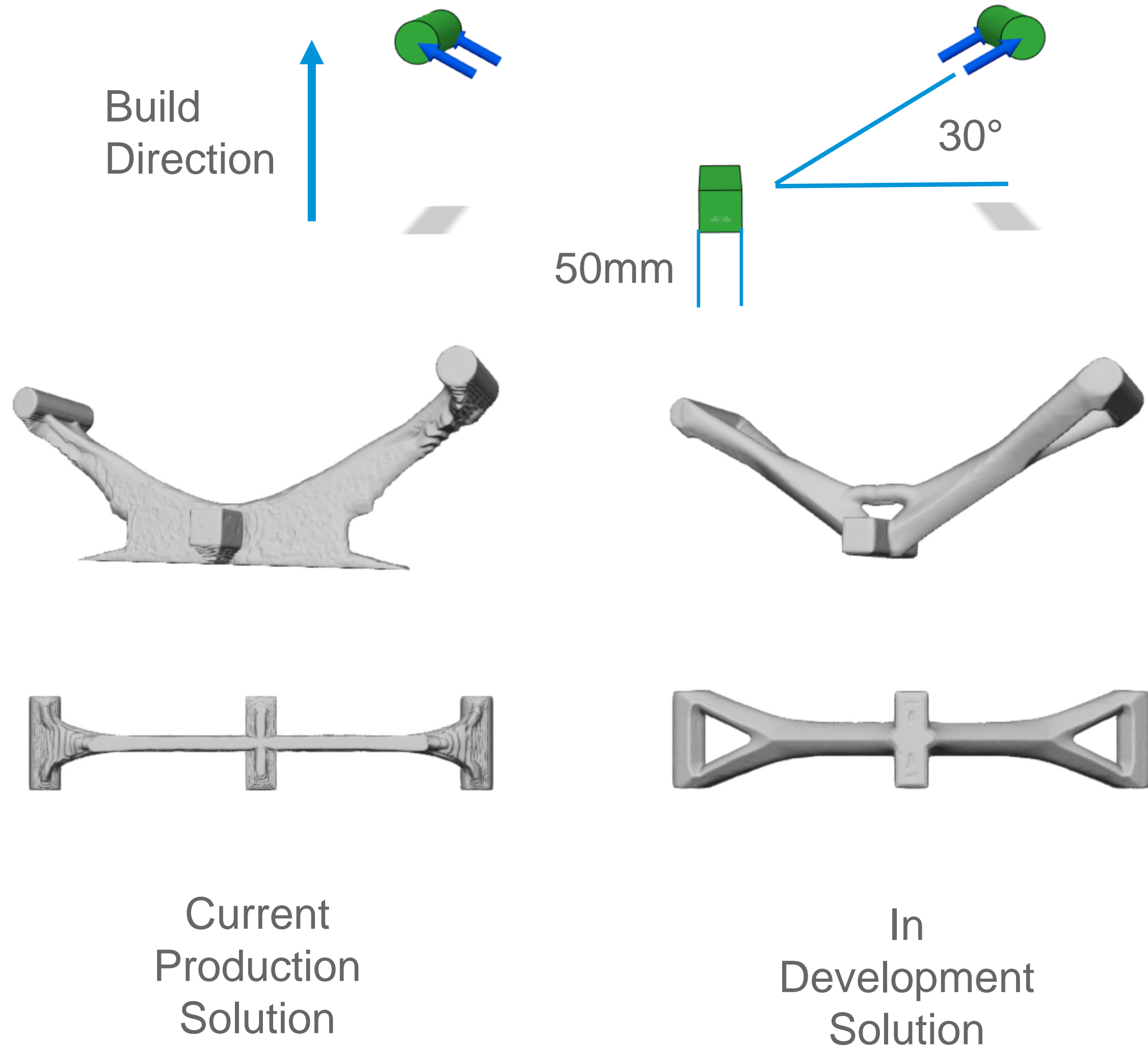
Design Space Tools



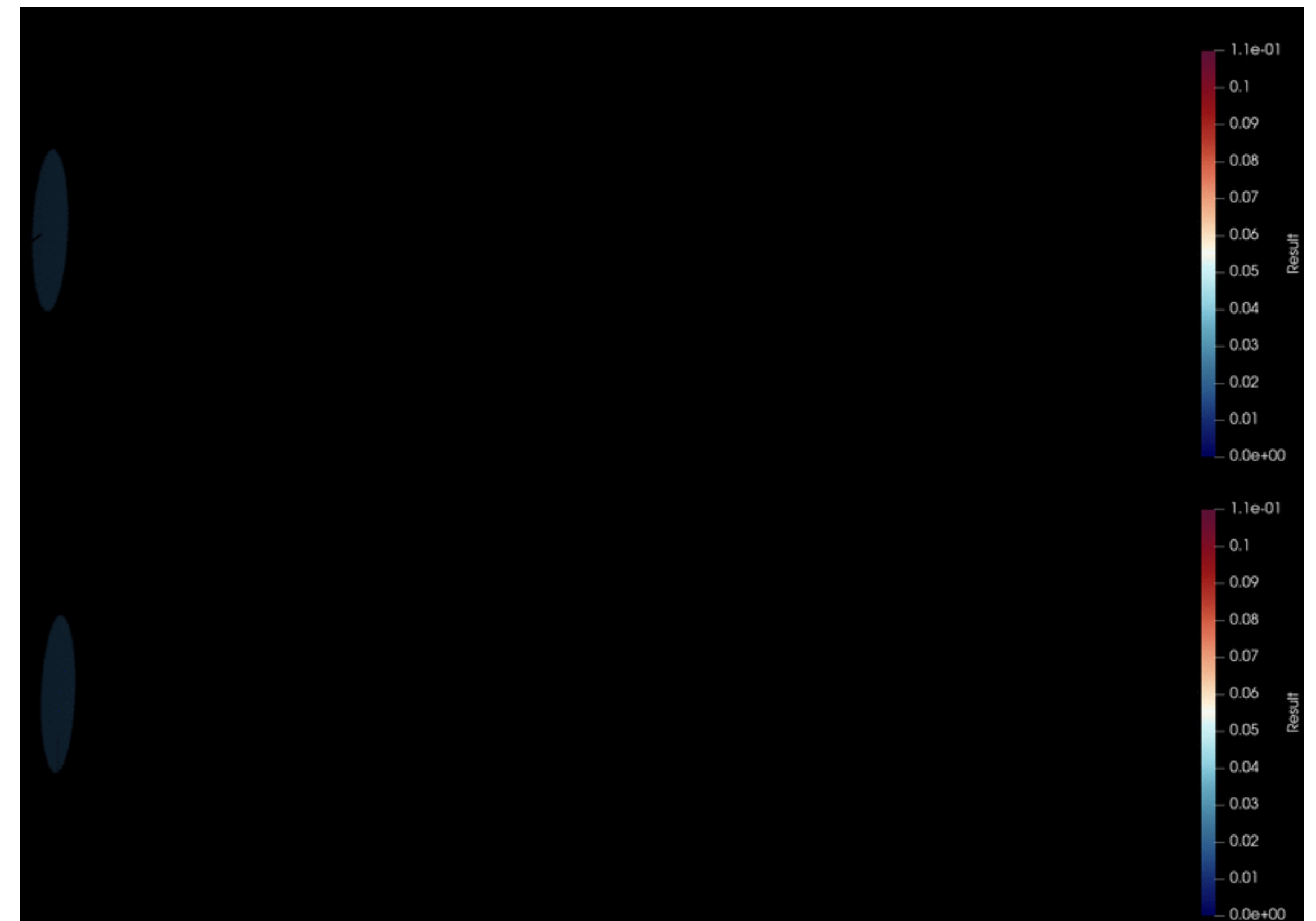
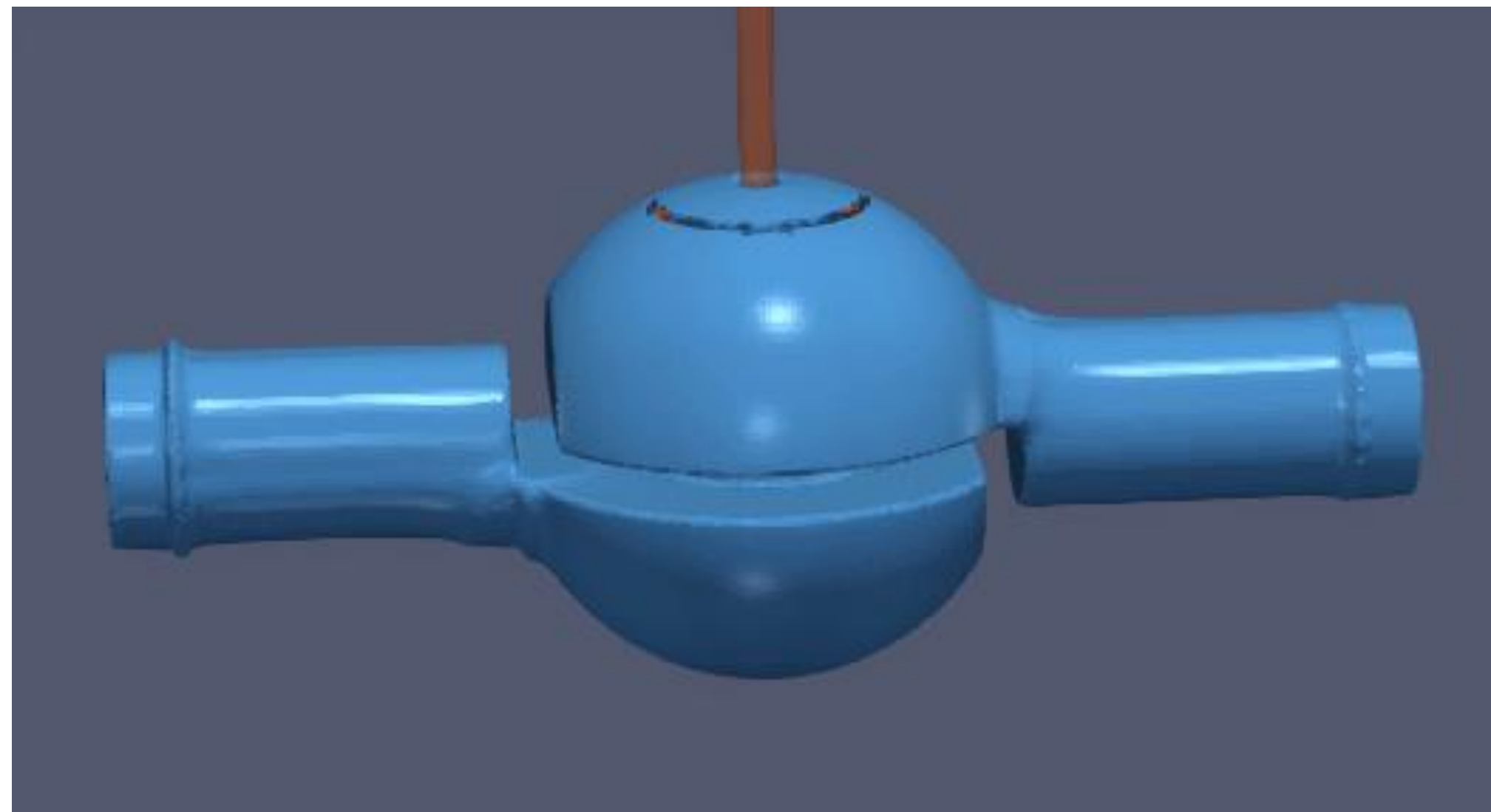
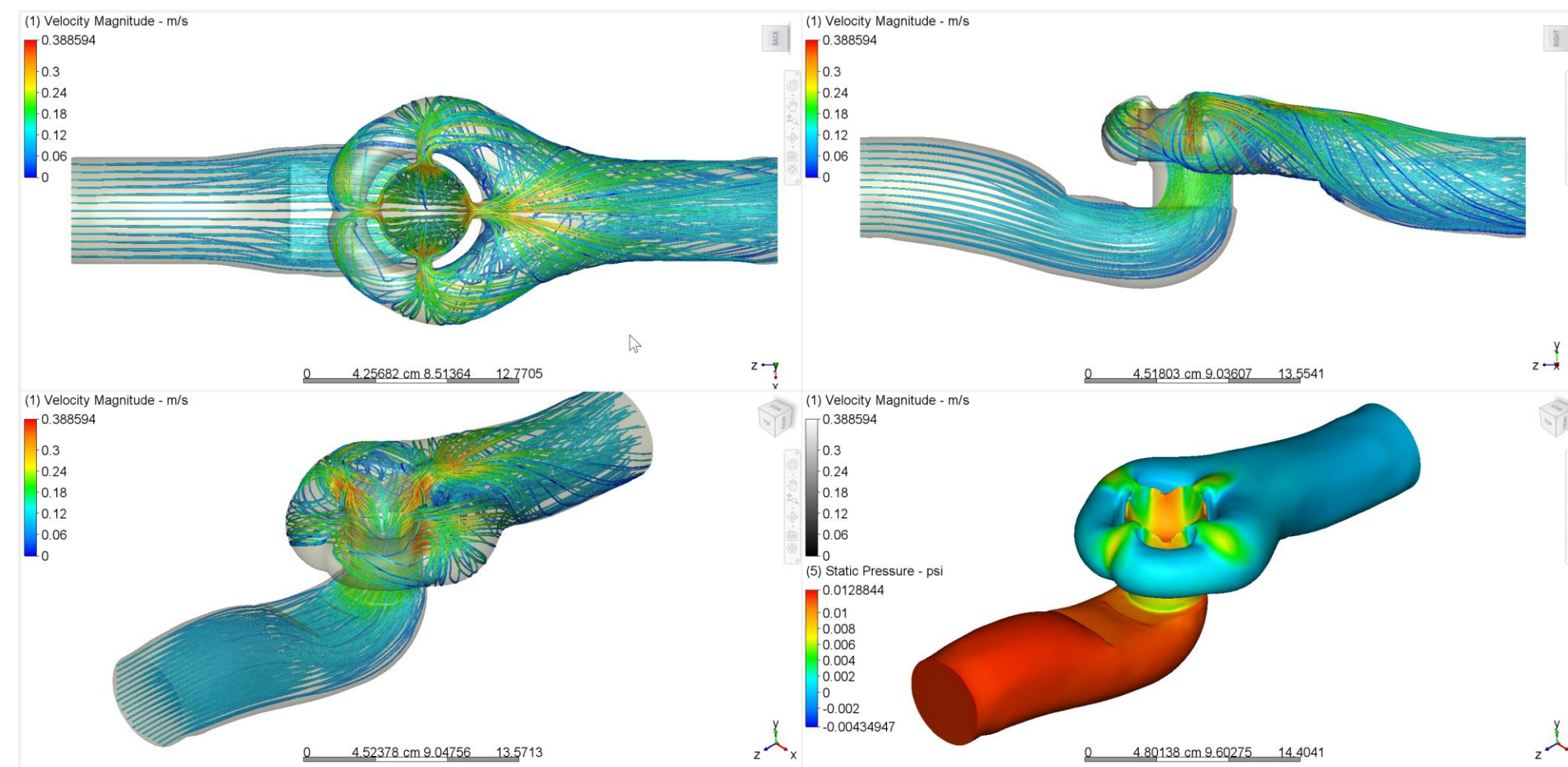
Inventor to Fusion 360



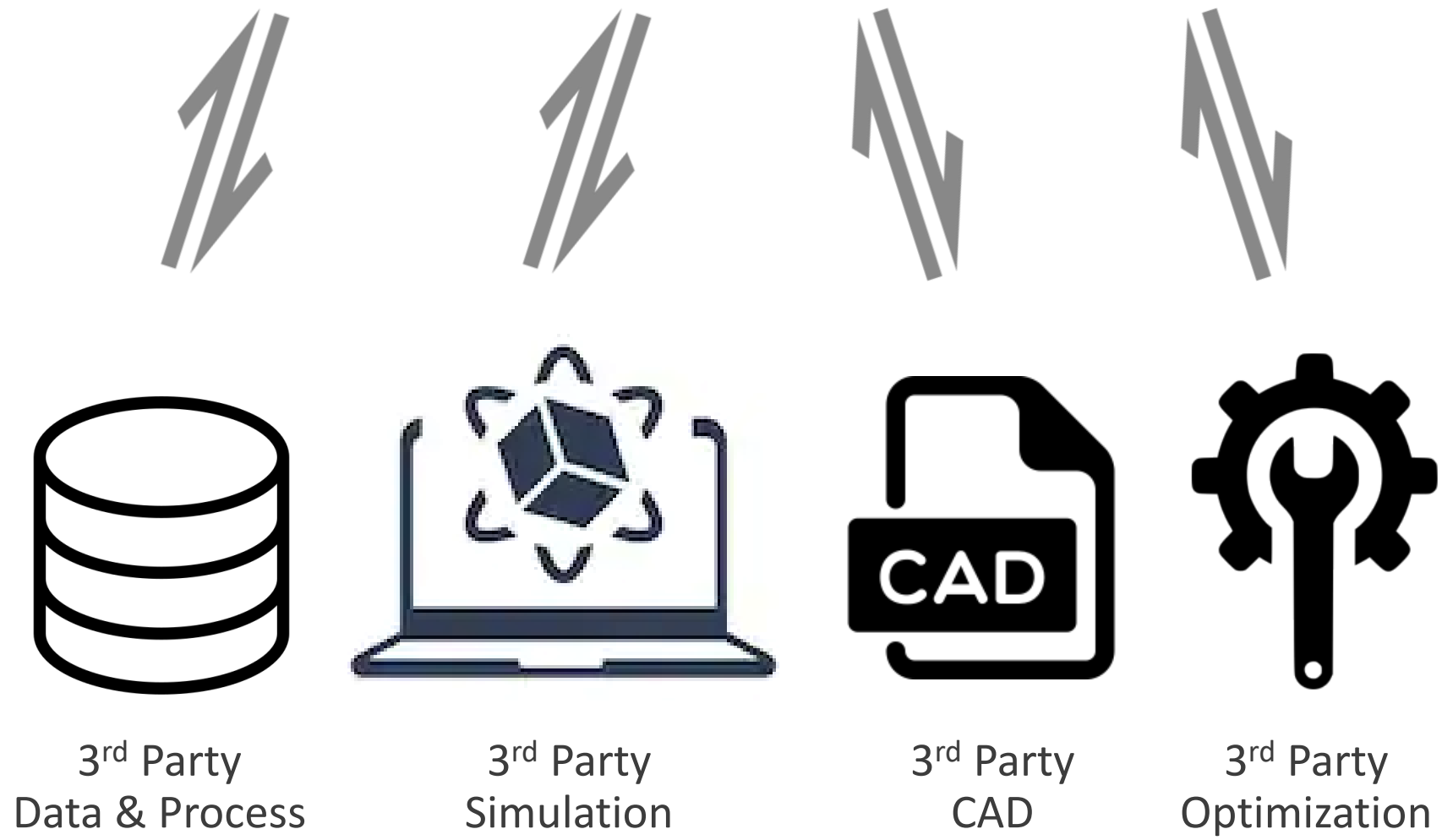
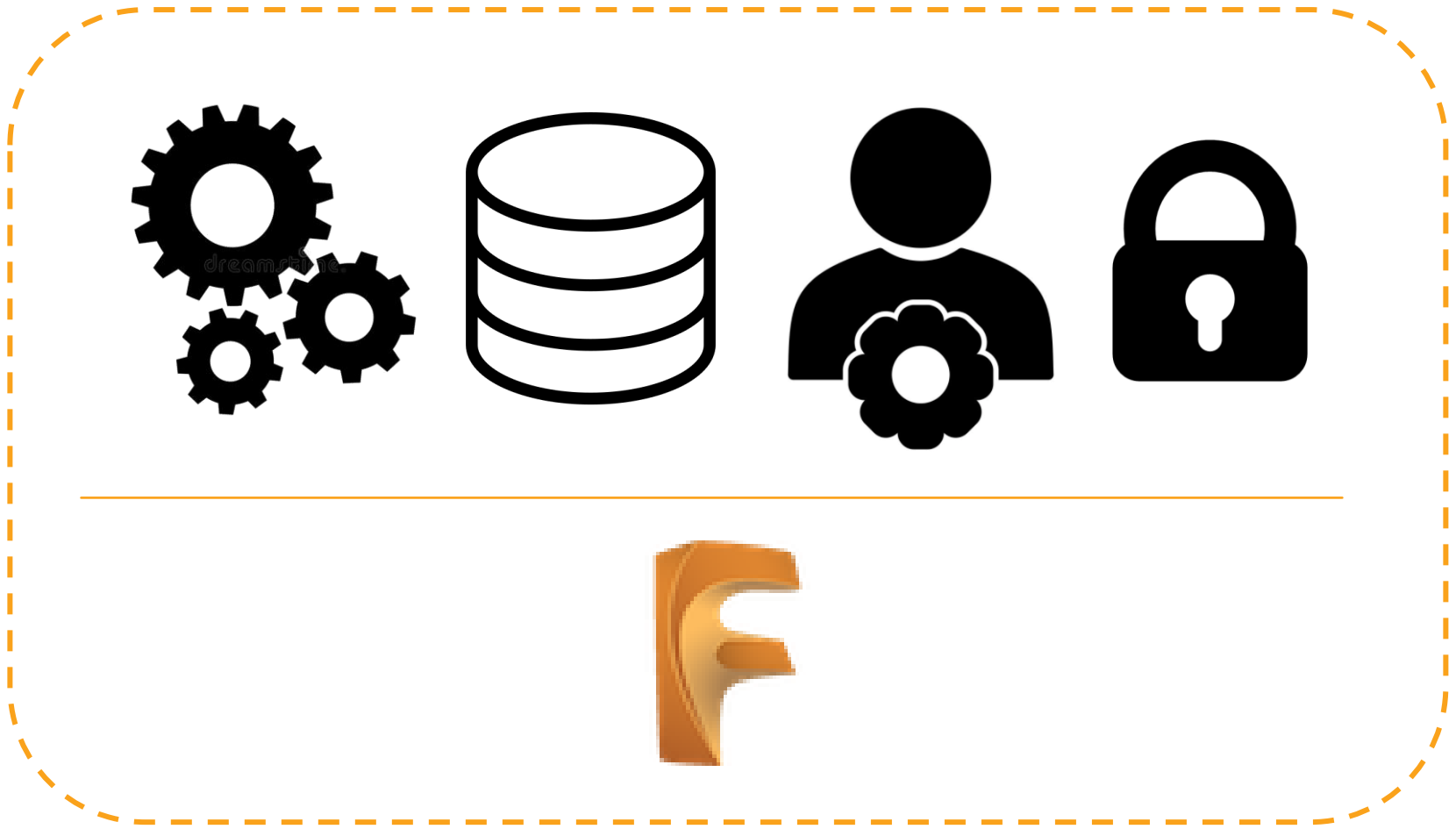
Additive MFG Constraint Improvements




Generative Fluids





API and Template Framework



Generative Design Resource Center

AUTODESK


FREE TRIALSPRODUCTSSEARCH

SIGN INUNITED STATES

DESIGN & MANUFACTURING


GENERATIVE DESIGN
RESOURCE CENTER

Generative design is changing the way manufacturers are designing and fabricating products. Access an expanding repository of generative design resources to inspire new ideas, deepen your skillset, and gain insight into the AI-driven technology.


 PLAY VIDEO (1:19 MIN.)

GET STARTED WITH GENERATIVE DESIGN


Generative Design Customer Stories



Creating one of the lightest wheels in the world with generative design
Using Generative Design with 3 and 5-axis milling, Briggs Automotive Company created new wheels that are 35% lighter.
[Learn more](#)



First 3D-printed snowboard binding designed by generative design
Lighter, stiffer, stronger. The next generation of snowboard bindings shreds with generative design.
[Learn more](#)



Exploring machinable options for motorcycle parts with generative design
MJK Performance, a Canadian motorcycle parts manufacturer, uses generative design to optimize triple clamps for 2.5-axis milling.
[Learn more](#)

GENERATIVE DESIGN ASSESSMENT
Autodesk Fusion 360 Generative Design Workflow

RELEASE 2020.2.4

intrinSIM LLC
www.intrinsim.com

GENERATIVE DESIGN ASSESSMENT
Autodesk Fusion 360
Generative Design Workflow


A market report from intrinSIM LLC

intrinSIM
CONNECTING WORLDWIDE
BUSINESS & TECHNOLOGY

© 2020 intrinSIM LLC


1

Ref: Fusion 360 GD Workflow assessment V2_4.docx

coursera


Browse > Physical Science and Engineering > Mechanical Engineering


Offered By

AUTODESK

Autodesk Generative Design for Manufacturing Specialization

Innovate with Generative Design for Manufacturing. Learn the foundations of product innovation and intelligent design with Generative Design for Manufacturing.

 4.8 318 ratings

 Autodesk

Enroll for Free
Starts Oct 20

Financial aid available

4,817 already enrolled

More questions...

GenerativeDesignHelp@Autodesk.com



Autodesk and the Autodesk logo are registered trademarks or trademarks of Autodesk, Inc., and/or its subsidiaries and/or affiliates in the USA and/or other countries. All other brand names, product names, or trademarks belong to their respective holders. Autodesk reserves the right to alter product and services offerings, and specifications and pricing at any time without notice, and is not responsible for typographical or graphical errors that may appear in this document.

© 2020 Autodesk. All rights reserved.

