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The What, When, and Why of Generative Design in Fusion 360

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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.

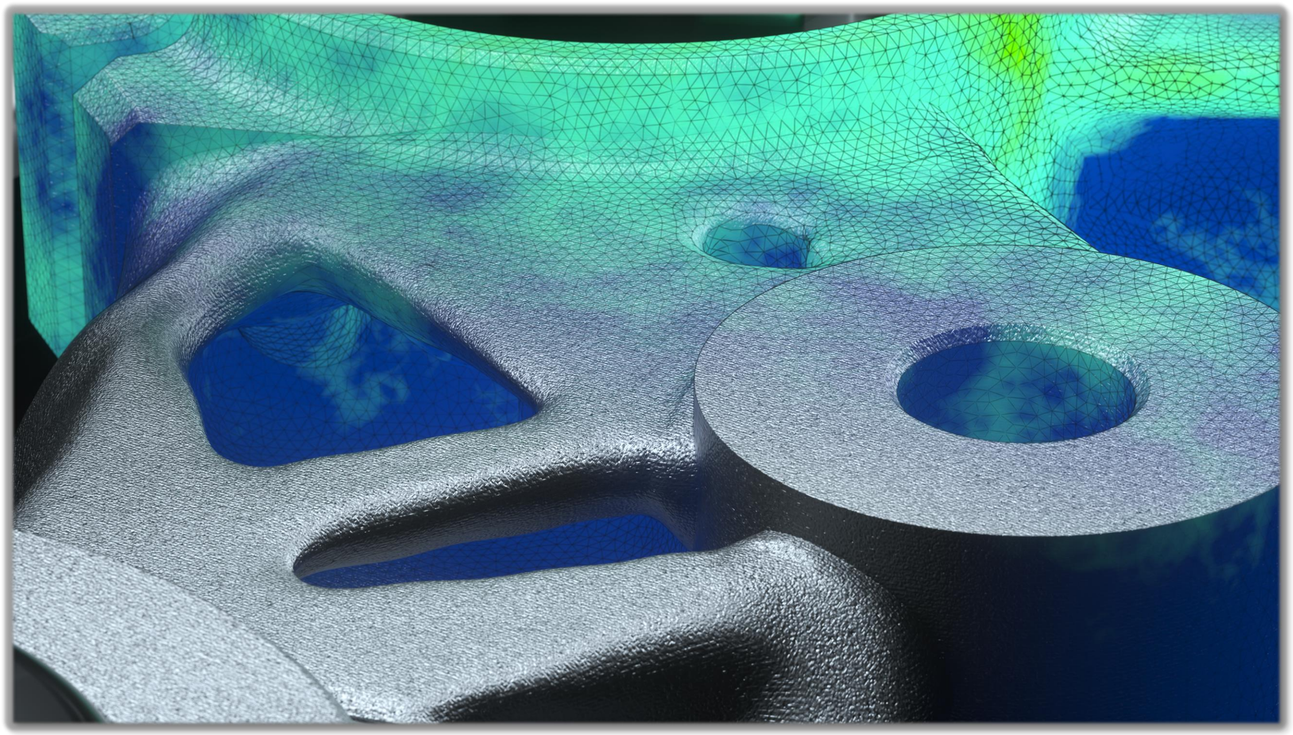
Ryan Abel

Product Technical Specialist, Fusion 360

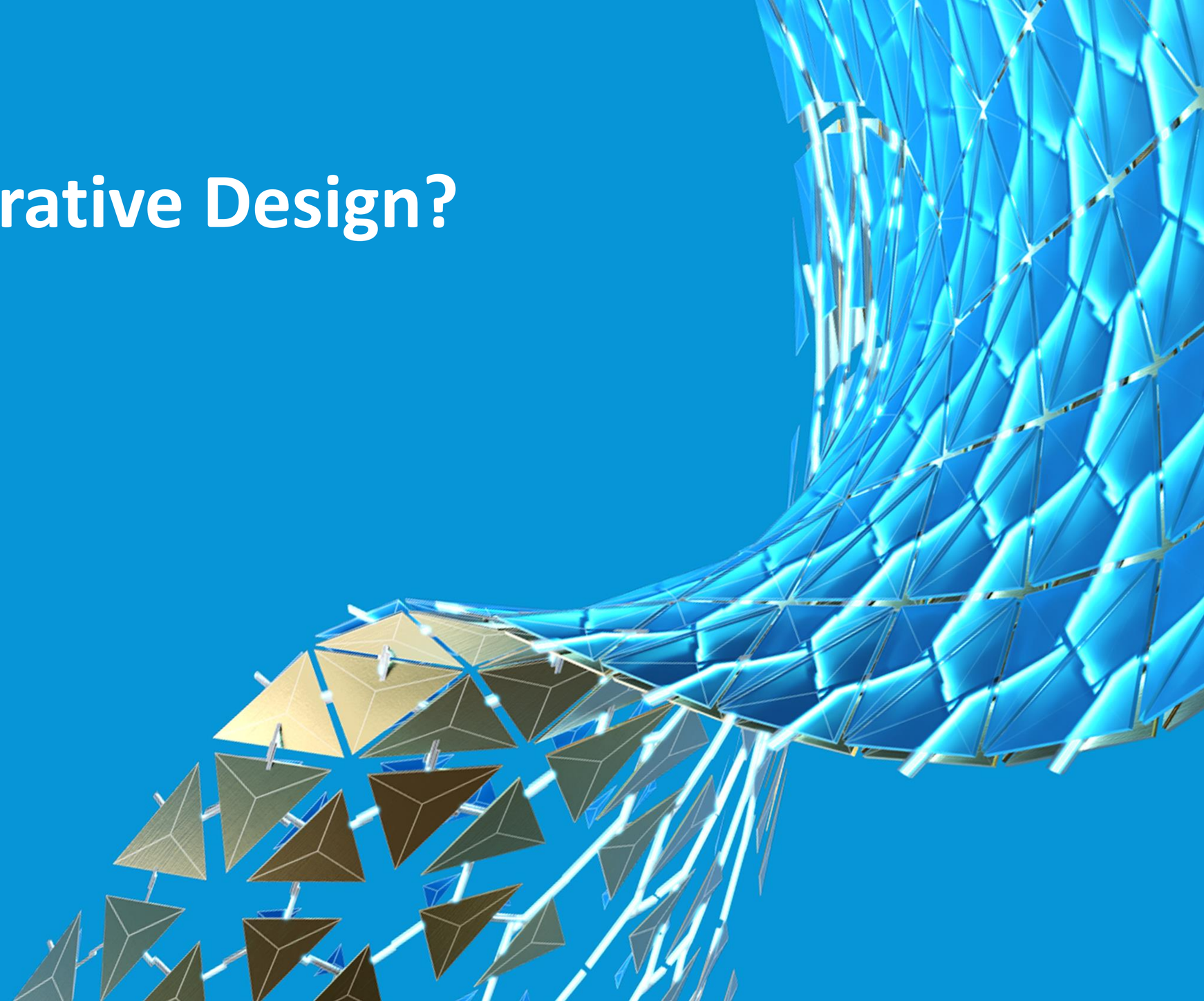
Ryan Abel has 20 years of Design, Engineering and Manufacturing experience. With his Master's Degree in New Product Introduction he became a Digital Prototyping expert using FEA, CFD and Moldflow to bring better products to market faster. At Autodesk, Ryan supported Global simulation growth training partners in US, Europe and Asia about sustainable business models for virtual testing and validation. In his current role, Generative Design Expert, Ryan leverages his vast industry experience and passion for customer success to help Fusion 360 users explore more viable design options, enabling engineers to innovate.

Agenda

- What is Generative Design?
- When is Generative Design a fit?
- Why Now?
- Closing Thoughts

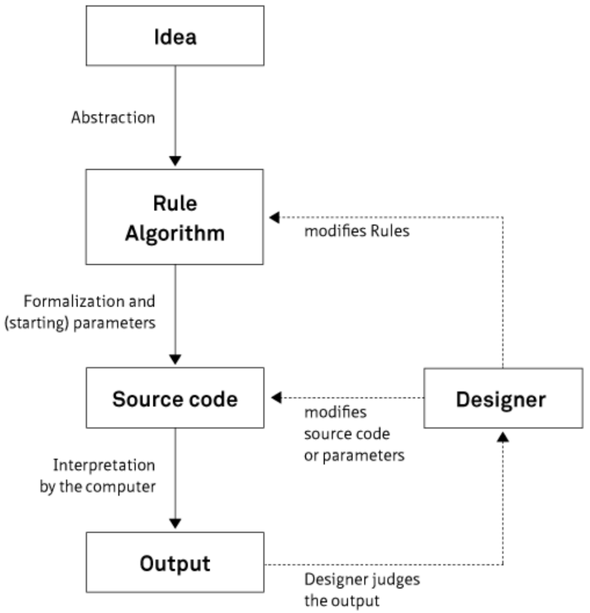


What is Generative Design?



What is Generative Design

- “Generative design is **an iterative design process** that involves a **program that will generate a certain number of outputs** that meet certain constraints, and a **designer that will fine tune the feasible region** by changing minimal and maximal values of an interval in which a variable of the program meets the set of constraints, in order to reduce or augment the number of outputs to choose from. The program doesn't need to be run on a machine like a digital computer, it can be run by a human for example with pen and paper. The designer doesn't need to be a human, it can be a test program in a testing environment or an artificial intelligence, for example a generative adversarial network. **The designer learns to refine the program (usually involving algorithms) with each iteration as their design goals become better defined over time**.” , Wikipedia https://en.wikipedia.org/wiki/Generative_design



Generative Design . . . Better Engineering

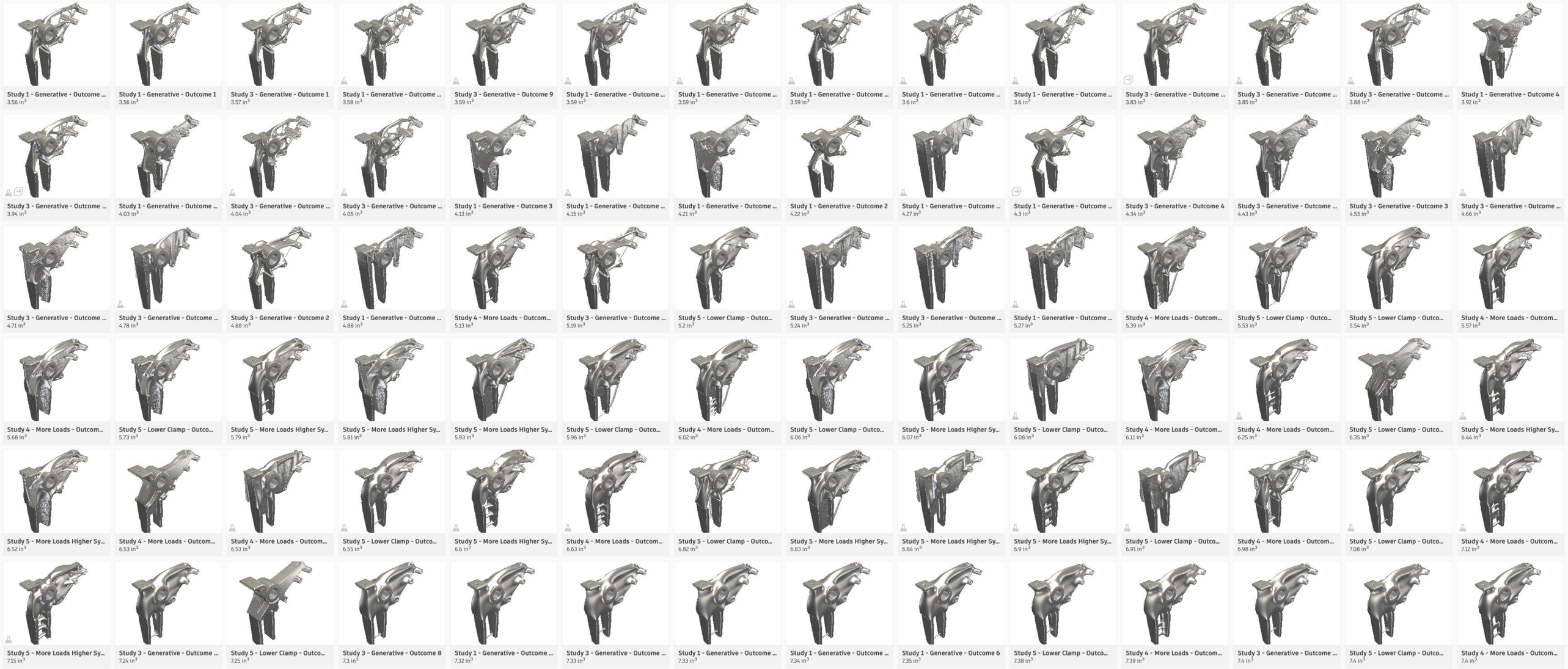
- Is an Iterative design process involving math and a designer
- Explores feasible design space, sorting key performance data
- Designer learns to refine the program with each iteration as their design goals and understanding of what is feasible evolves

What is Autodesk’s Generative Design

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

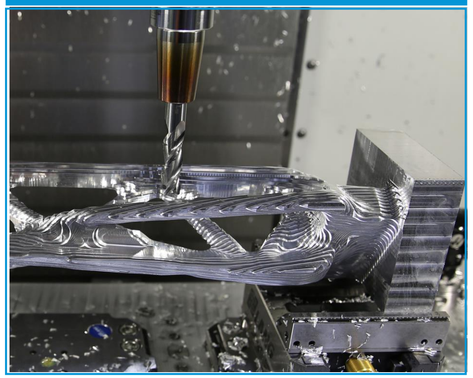
Simultaneously generate multiple CAD-ready solutions based on real-world manufacturing constraints, cost evaluation and product performance requirements

Multiple Design Solutions in Parallel

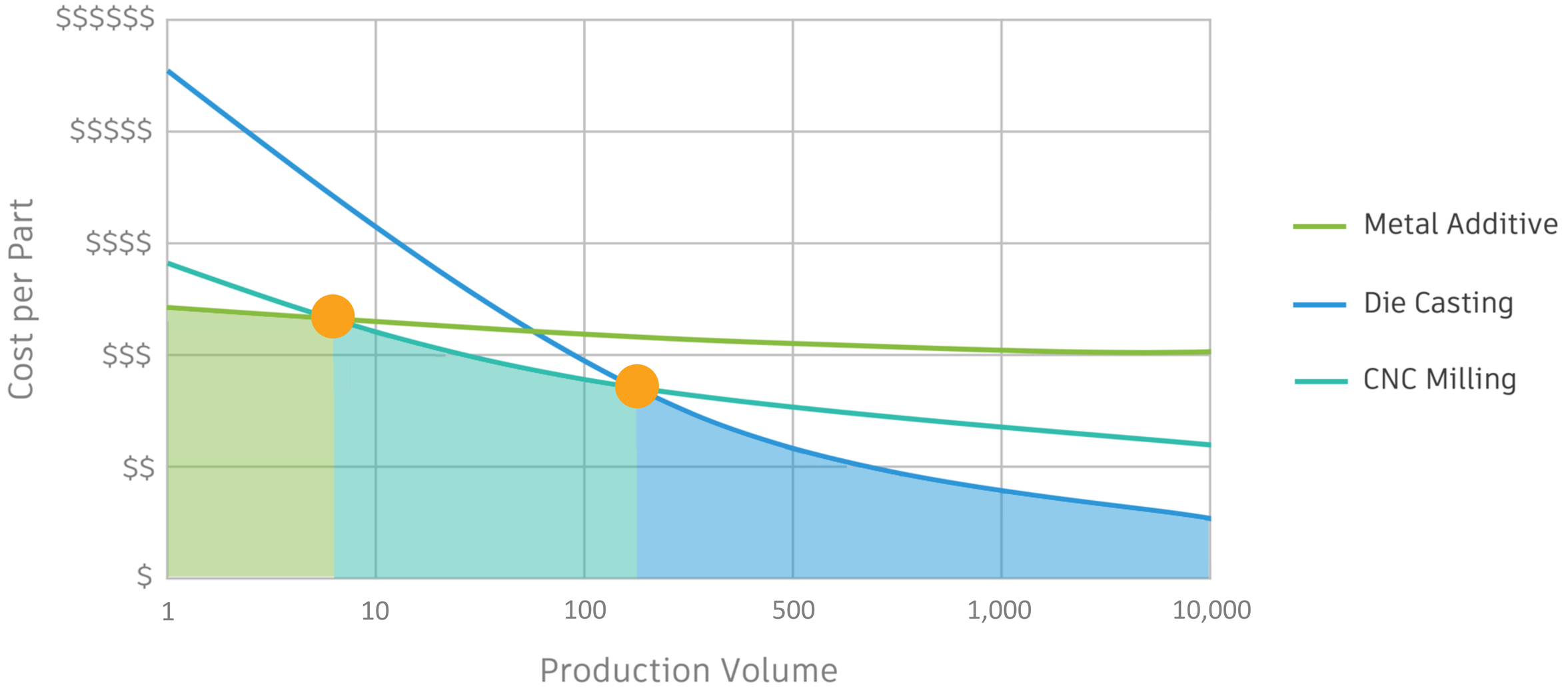


Multiple Manufacturing Methods

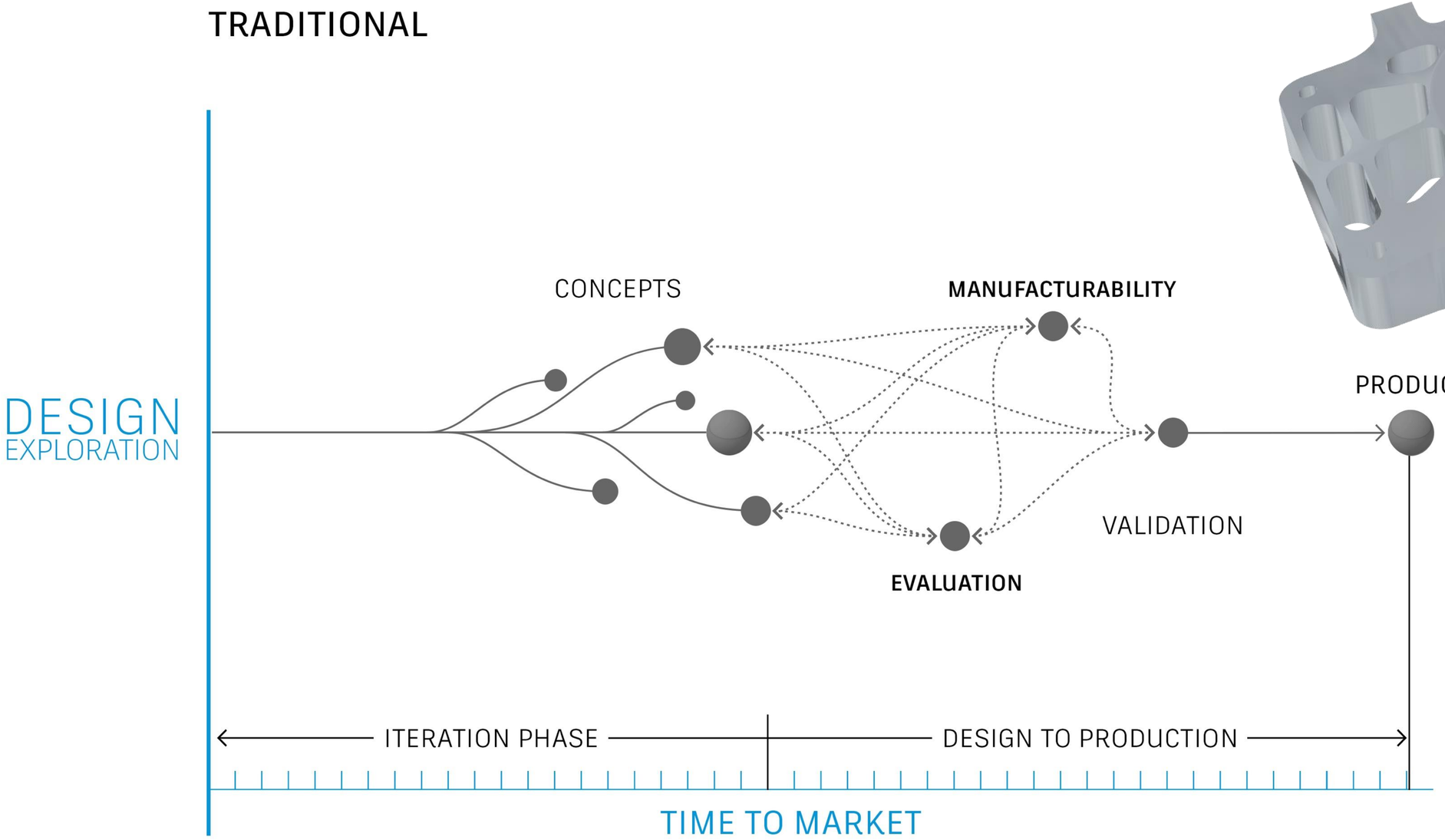
Manufacturing ready design

Additive Manufacturing	Die Casting	3 & 5 Axis Milling	2.5 Axis Milling	2 Axis Cutting
				

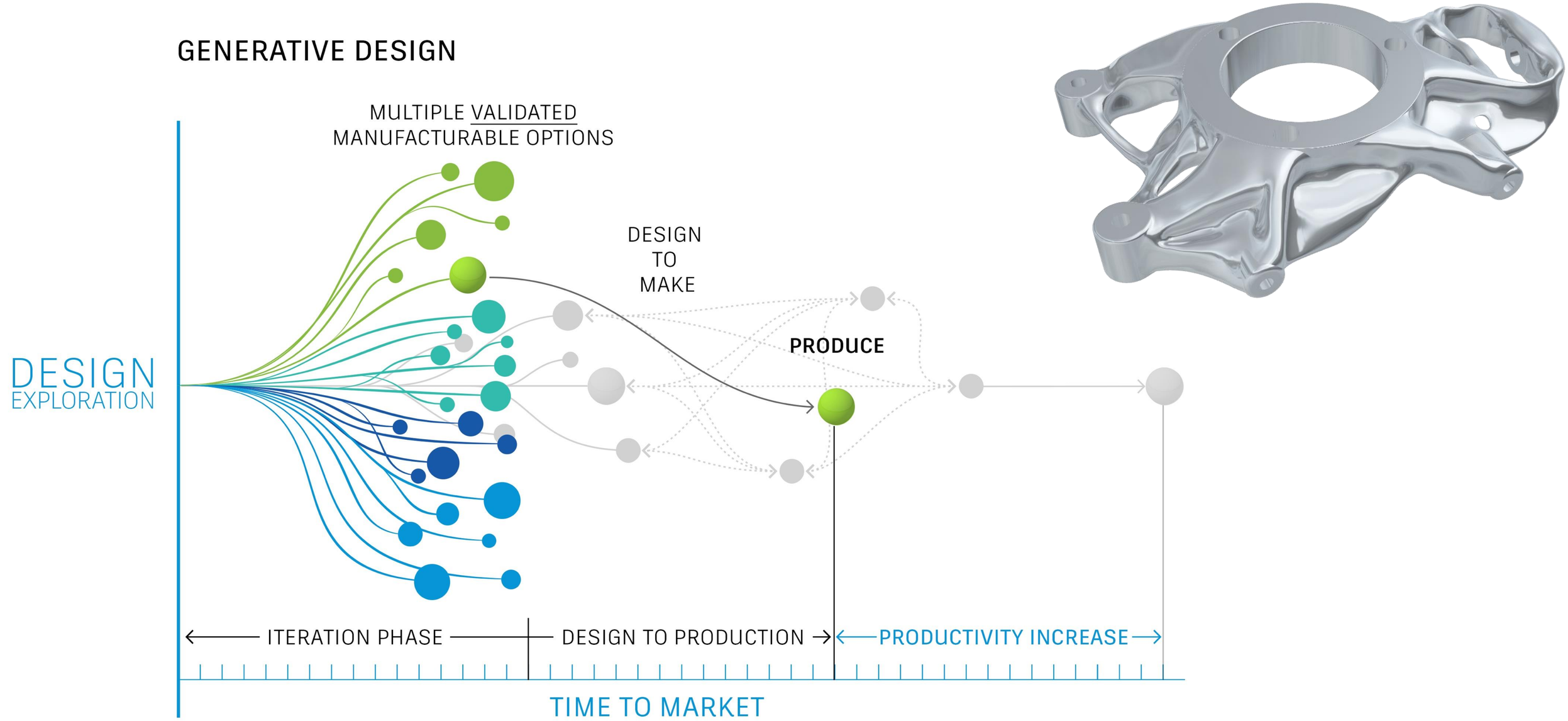
Multiple Cost Insights



The Traditional Product Development Process



Generative Design in Fusion 360



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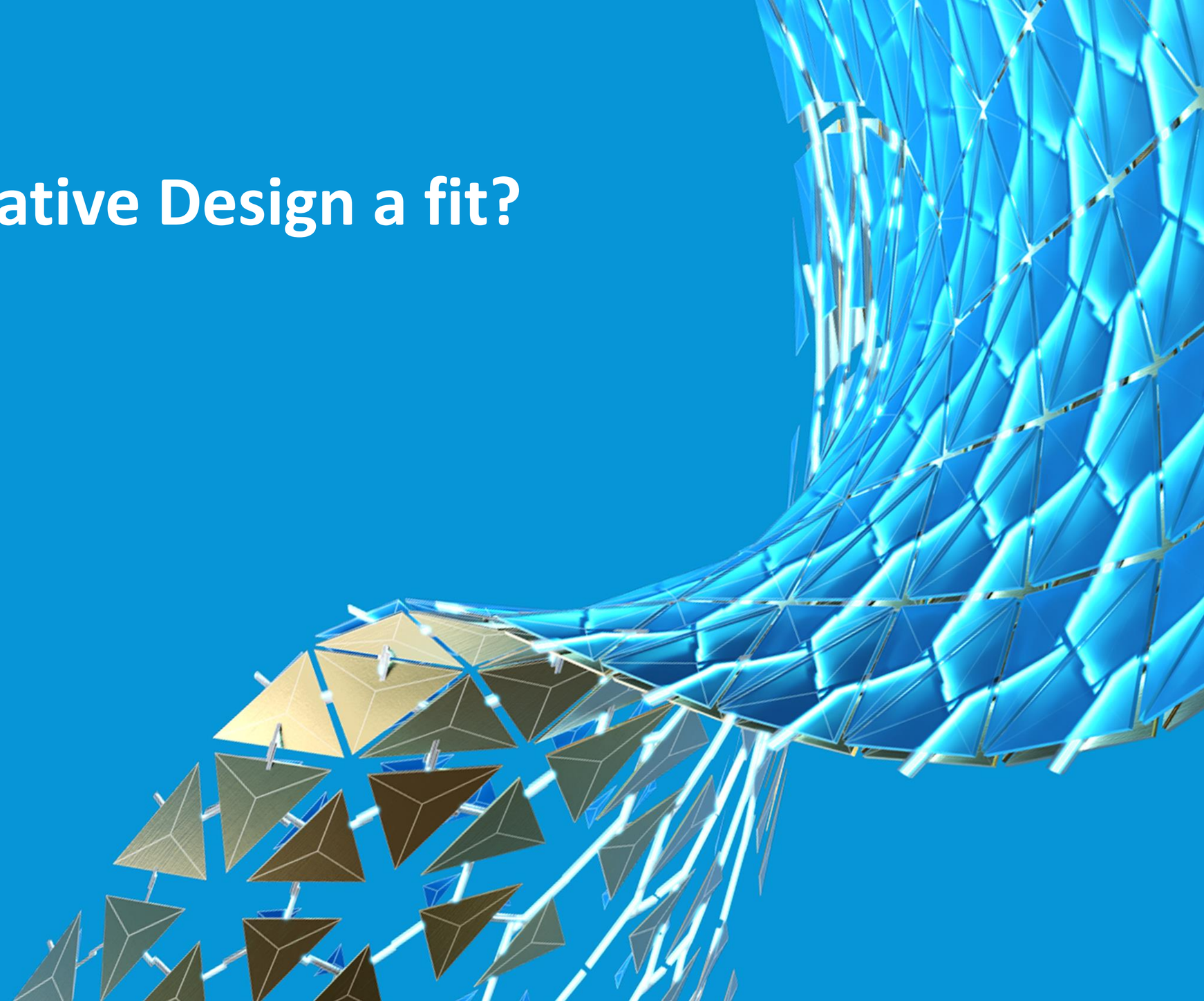
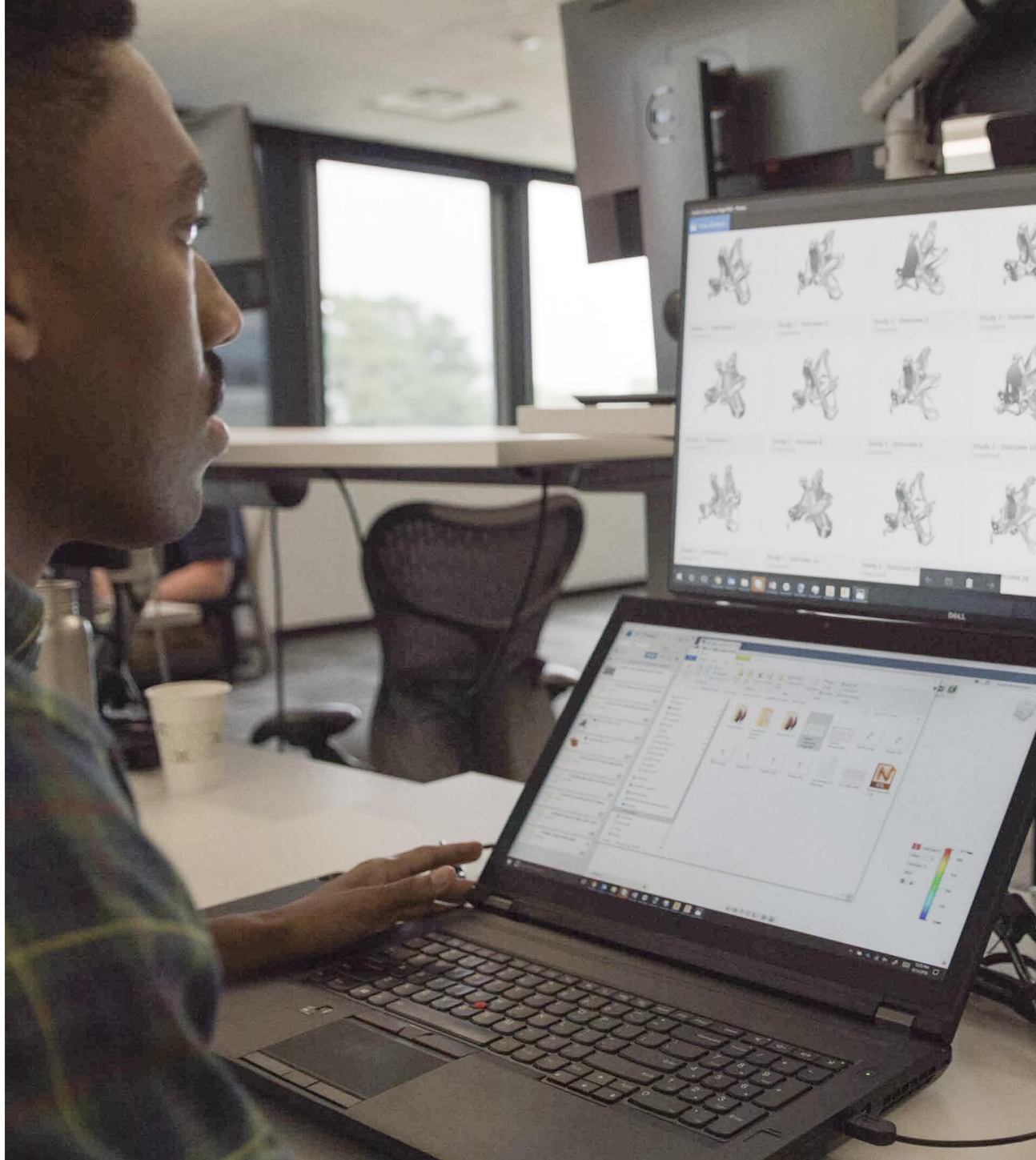
When is Generative Design a fit?



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.



When Generative Design?

Most Common Project Categories

New Product Proposals
Win bids with creative ideas
Predictable cost

Design Evolution
Incremental improvements are a thing of the past
More design concepts in less time

Manufacturing Support
The “things” that makes the product you sell
Data re-use and faster production

Before and After
24-hour Generative Design Process

HONDA

“I was impressed by how the software offered a configuration I had not even considered as a designer.”

Hirosumi Todaka, Honda R&D Co., Ltd
Redshift, 2020 publication

Source: Honda

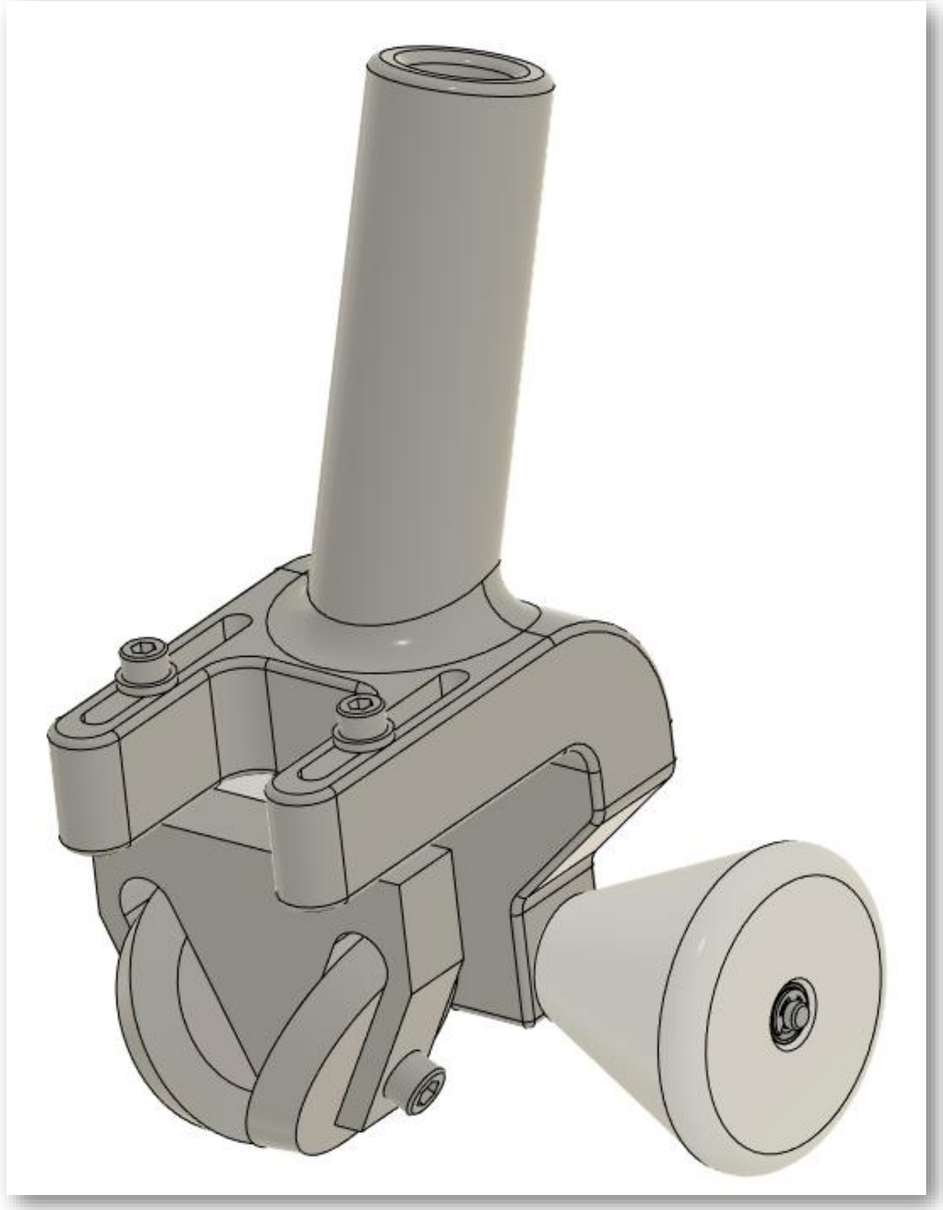

GOODYEAR®

Mark J Montgomery, P.E.

Principal Engineer, Tire Assembly Systems

Production Hand Tool Re-Design

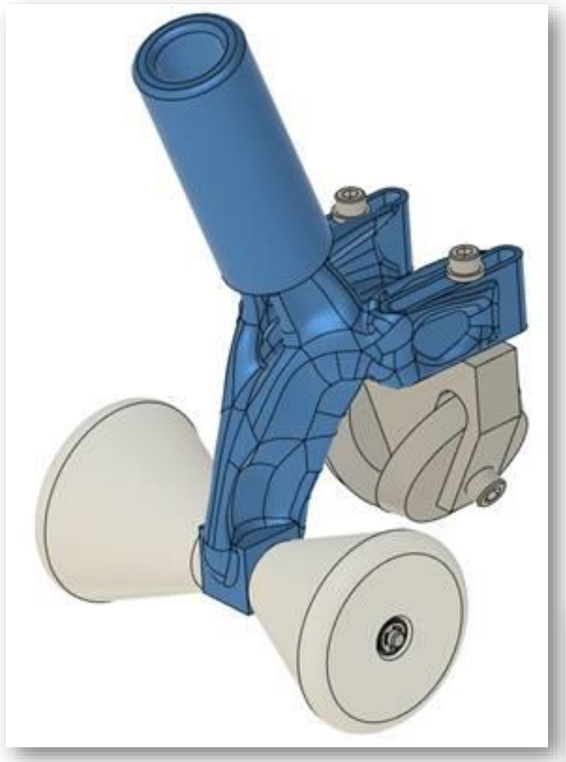
- Interested in “what’s possible” with generative design
- Focused on driving cost reduction and improving performance
- Looking to reduce time to market
- Currently machined from aluminum
- Hundreds of other “similar” tools like this



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

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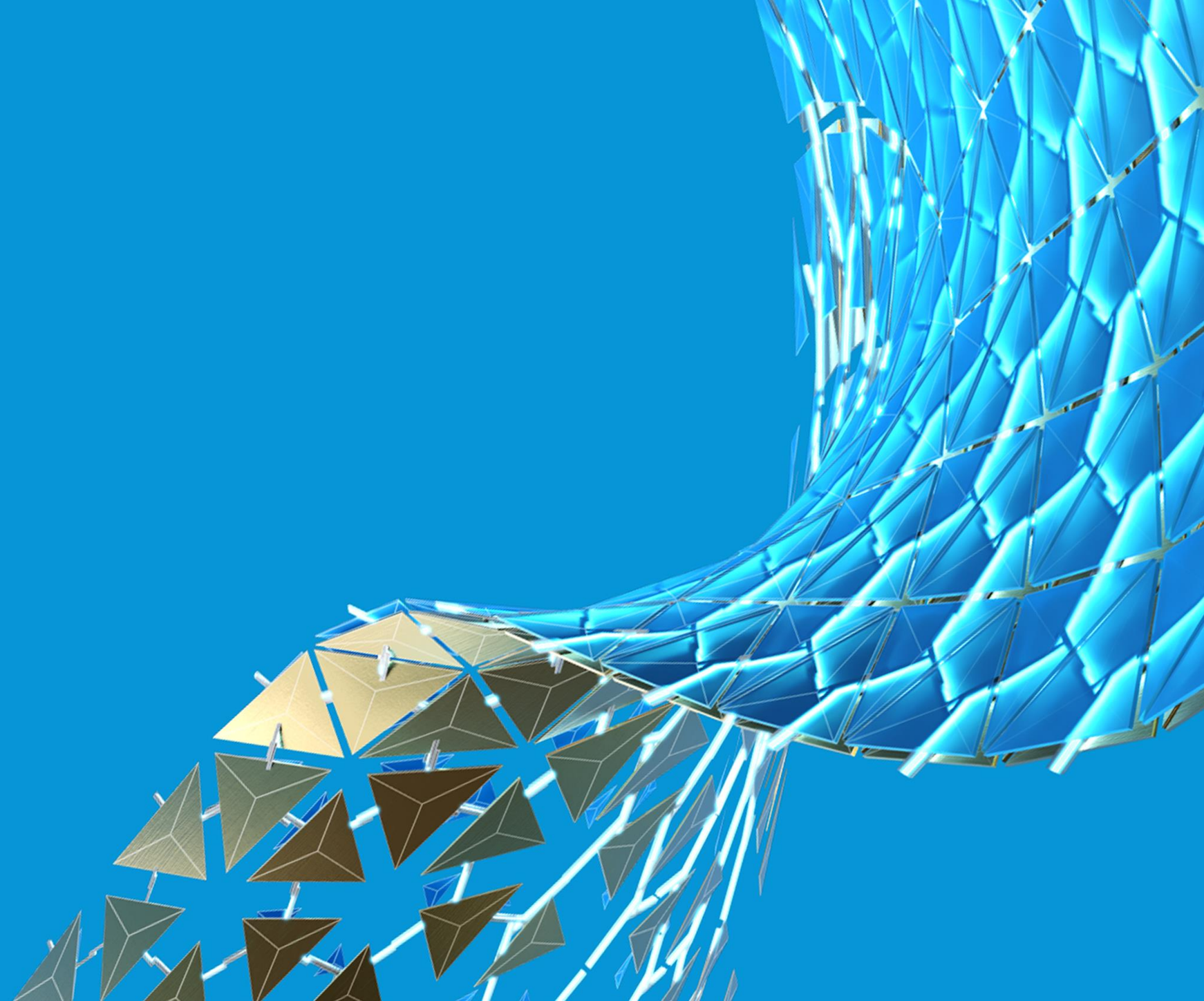
Why Now?



Generative Design | Industry Headlines

Generative design could reshape the future of product development

McKinsey&Company

Generative design opens new paths to a sustainable future

Forbes

Harvard Business Review

The next wave of intelligent design automation

Machine learning takes the guesswork out of design optimization

WIRED

Everyone is talking about Generative Design

Generative Design is no longer just research

Leadership, Engineering & Manufacturing
Invest in new talent, change engineering culture

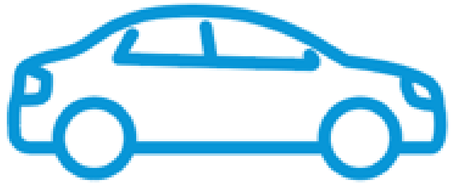
R&D Engineers
Design for Advanced Manufacturing and pushing the limits of the possible

CAE Analysts
Explores more feasible topologies than just TO

Mechanical Engineers
Designing and improving products / projects

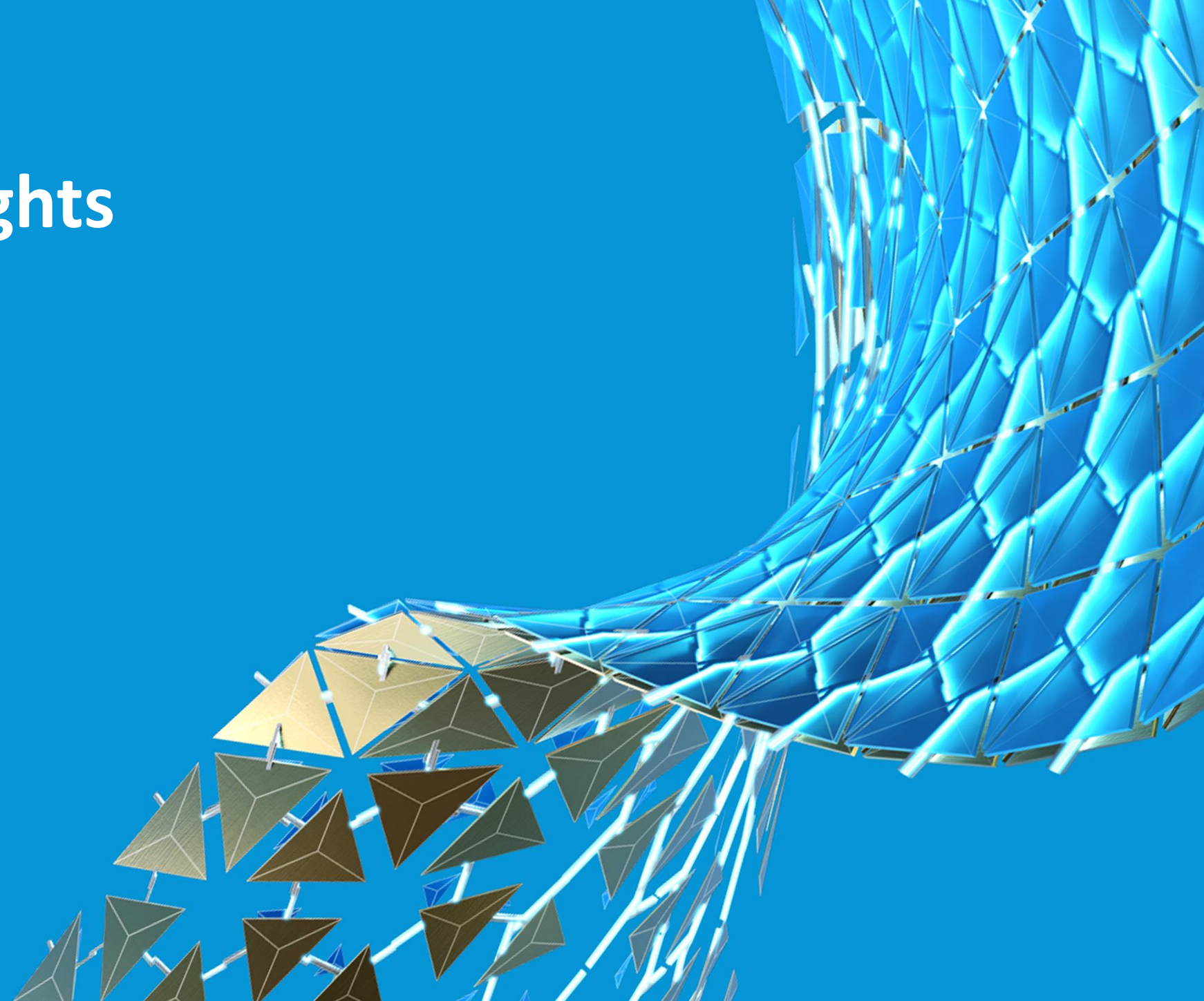
Manufacturing Specialists
Design for additive is a natural fit for organic designs and production tooling

Human skillset, software is just the vehicle



Better Engineering

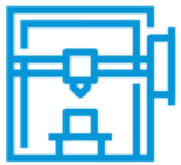
Closing Thoughts



When + Why: Process Improvement

Upfront Design - Ideation, get the creative sparks going

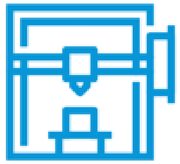
Early Design Development - Art of the feasible, better decision making



DFM - Cost Reduction and Design Automation

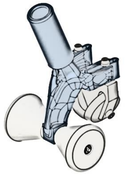
Topology Optimization - Optimal, cost and performance

When + Why: Application Fit



DfAM - Upskill Your Organic Design Skills for Cost and Sustainability

Creating Prototypes - Explore Design Space with CAD Automation



Manufacturing Tooling - Automate CAD for Low Volume Tools

Light Weighting - Performance, Cost, Sustainability

Generative Design = Better Engineering

Generative Design Resource Center