AUTODESK UNIVERSITY

Using Additive Manufacturing Technology via Autodesk Fusion 360 and Inventor

Rob Bowerman
Sr. Technology Consultant

Chris Mitchell
Sr. Principal QA Engineer

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About the Presenters

Chris Mitchell

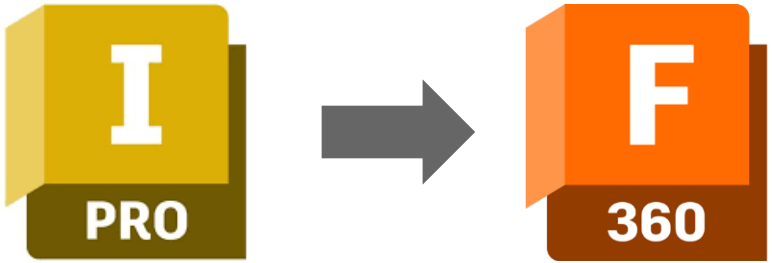
A Sr. Principal QA Engineer based on the PDMS Customer Engagement team. His primary focus points is to manage all aspects of pre-release validation (Alpha/Beta) for Inventor & Fusion 360. He and his team work closely with customers, partners, and development teams to ensure that the “Voice of the Customer” is continually heard to improve product quality. Chris has also had active roles as the manager of Inventor Experience Design/User Research & as a UX lead; he has worked at Autodesk for 17 years. Prior to joining Autodesk, Chris worked in various consulting roles for CAD/PLM product implementation, & as a Mechanical Design Engineer for British Steel specializing in the design & FEA analysis of hot-rolling process equipment. He is a Chartered Engineer & a Fellow with the UK’s Institute of Mechanical Engineers

Robert Bowerman

A Senior Technology Consultant at Autodesk, based in the Fusion360 product team, working in the field of Additive Manufacturing. Robert’s work includes collaborative work with industrial partners and internal R&D to create the future workflows for Additive Manufacturing processes, with a focus on Directed Energy Deposition and Powder Bed Fusion. Robert’s motivation is to drive innovation within AM to achieve scale and adoption throughout the supply chain, such that its potential can be realised in real world applications.

Content

- What to Expect from this Talk
- Presenter Introduction
- Why Inventor to Fusion 360?
- Inventor to Fusion 360 Workflow Demonstration
- Metal Additive Manufacturing
  - Which process does Fusion 360 support?
- Use Case
- Closing Remarks



What to Expect from this Talk

Using Additive Manufacturing Technology via Autodesk Fusion 360 and Inventor

- Metal Additive Manufacturing
- Fusion 360 Design and Manufacturing capabilities specific to Metal AM
- Inventor to Fusion 360 workflow
- Demonstration of Metal AM with customer example

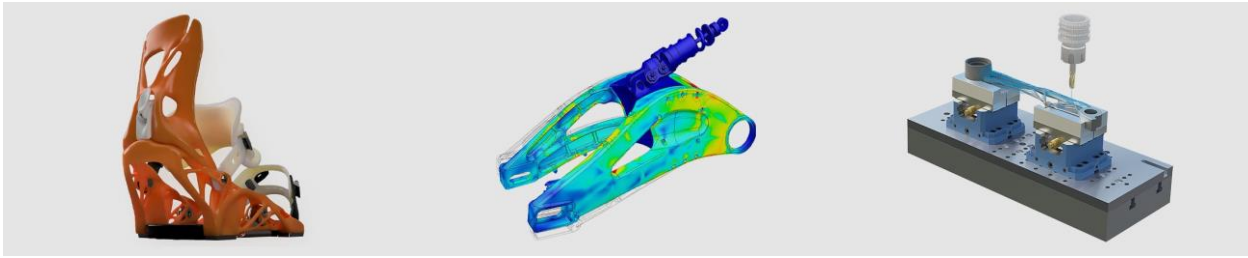
Inventor to Fusion 360

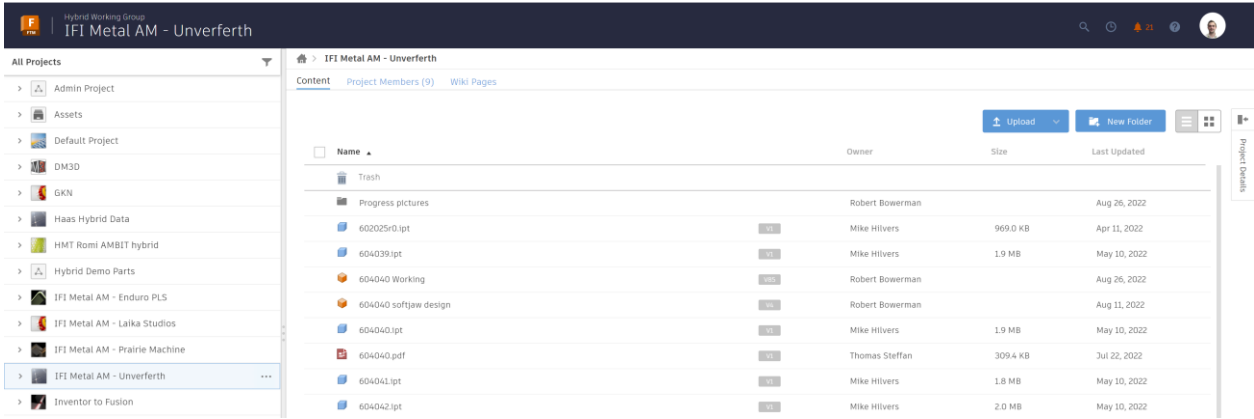
New Workflows

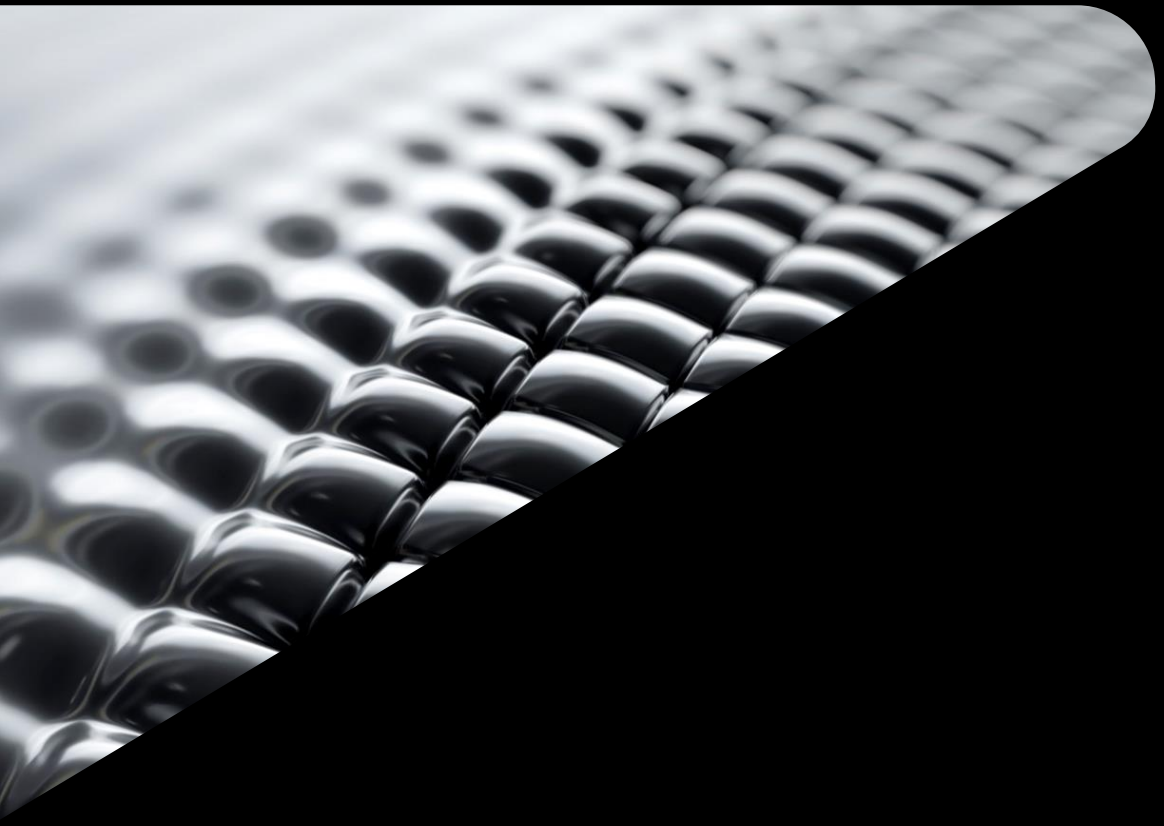
- Inventor 2023 now includes new and improved interoperability tools for Inventor to Fusion 360

- Enable additional workflows
  - Design
  - Simulation
  - Manufacturing

- Improved collaboration
  - Across teams
  - With external vendors



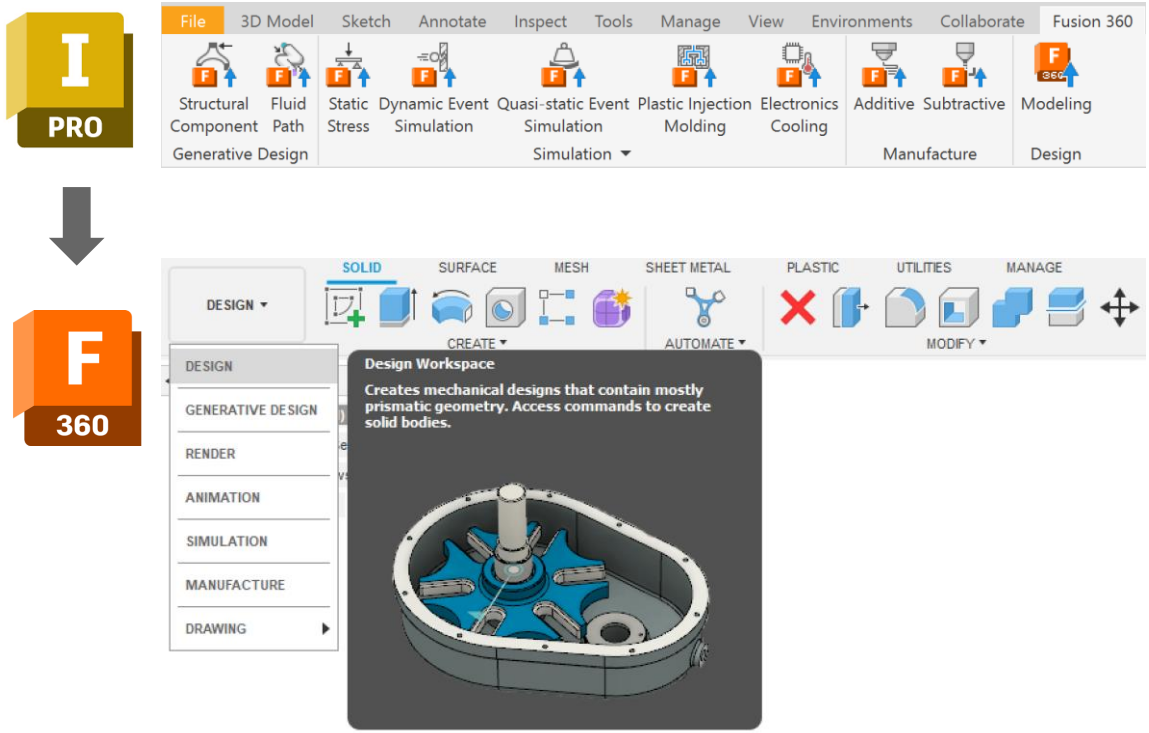




Inventor to Fusion 360 Workflow

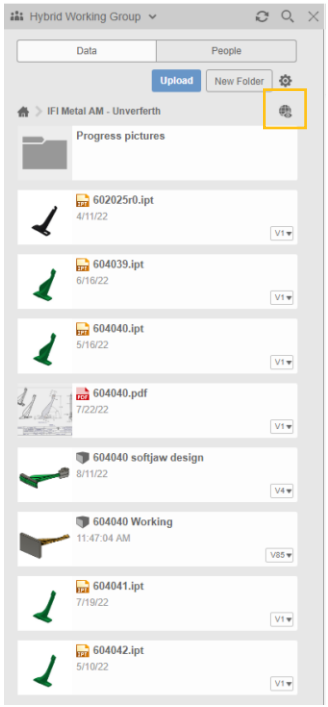
Inventor to Fusion 360 Workflow

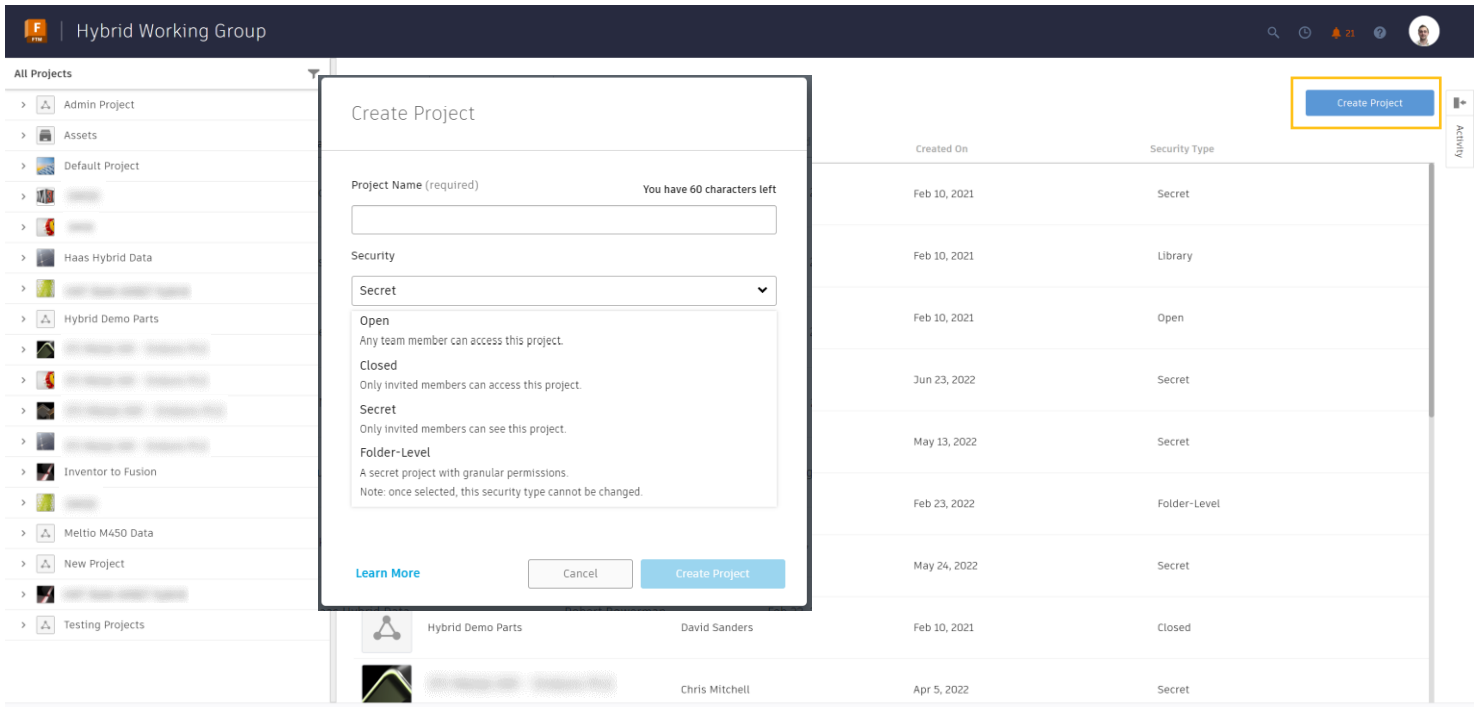
- New Fusion 360 tool bar within Inventor 2023
- Workflows for all major Fusion 360 workspace
  - Design
  - Generative Design
  - Simulation
  - Manufacture

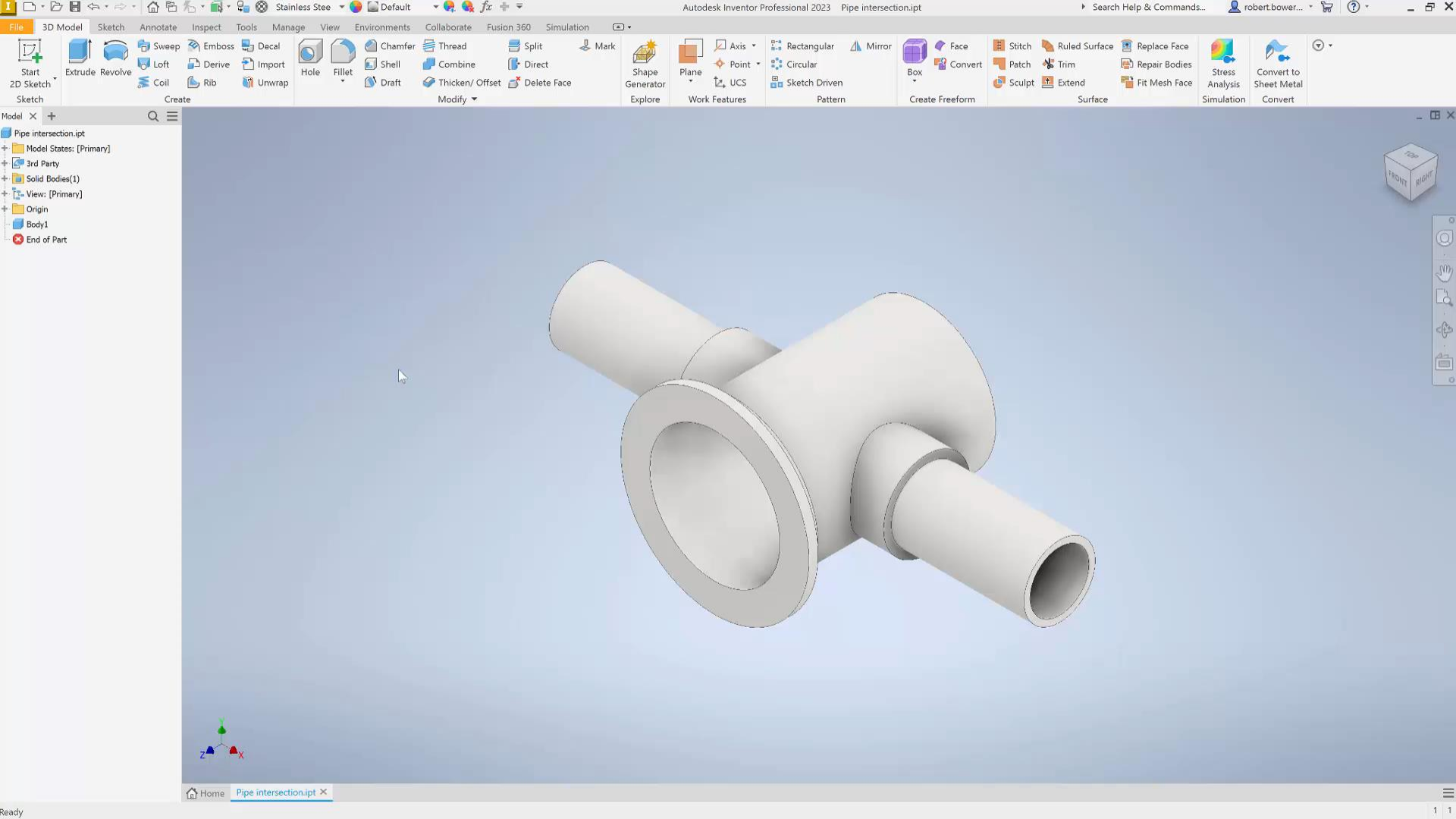


Inventor to Fusion 360 Workflow

Fusion Teams






Autodesk Inventor Professional 2023
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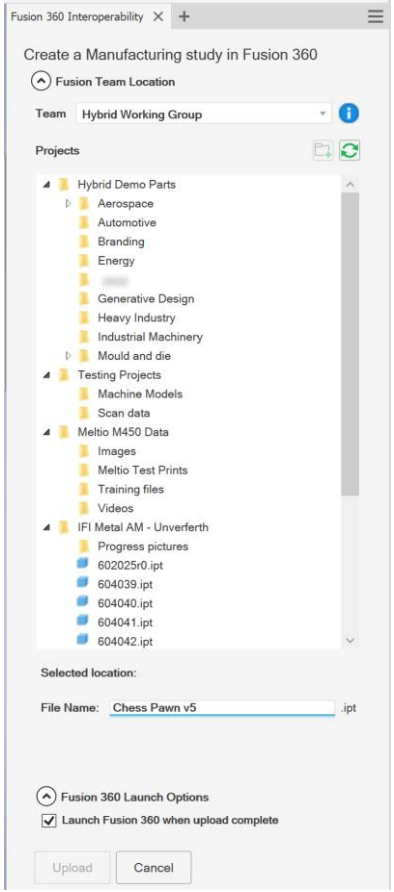
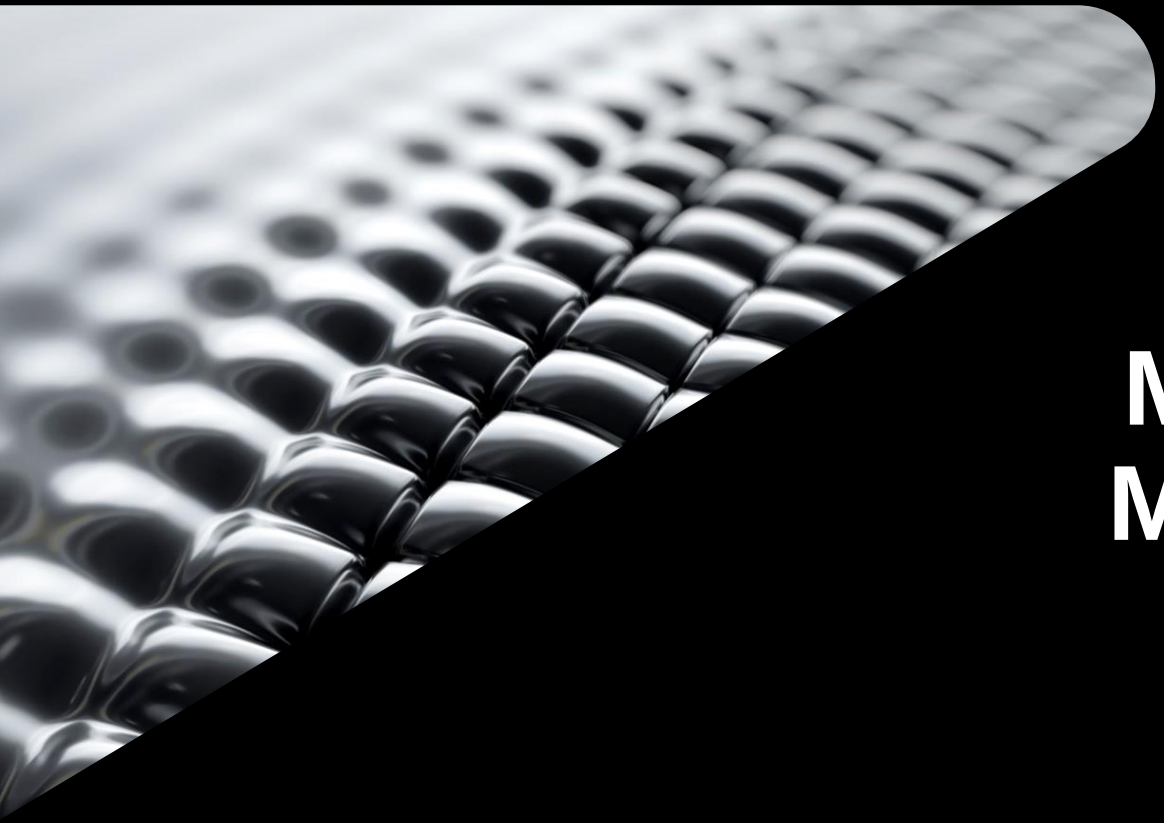
File
3D Model
Sketch
Annotate
Inspect
Tools
Manage
View
Environments
Collaborate
Fusion 360
Simulation
Start 2D Sketch
Extrude
Revolve
Sweep
Loft
Coil
Emboss
Derive
Rib
Decal
Import
Unwrap
Hole
Fillet
Chamfer
Shell
Draft
Thread
Combine
Thicken/ Offset
Split
Direct
Delete Face
Mark
Shape Generator
Plane
Axis
Point
UCS
Rectangular
Circular
Sketch Driven
Mirror
Box
Face
Convert
Stitch
Patch
Sculpt
Ruled Surface
Trim
Extend
Replace Face
Repair Bodies
Fit Mesh Face
Stress Analysis
Convert to Sheet Metal
Sketch
Create
Modify
Explore
Work Features
Pattern
Create Freeform
Surface
Simulation
Convert
Model
Pipe intersection.ipt
Model States: [Primary]
3rd Party
Solid Bodies(1)
View: [Primary]
Origin
Body1
End of Part
Home
Pipe intersection.ipt
Ready

Inventor to Fusion 360 Workflow

Useful things to know

- Folder-level projects are not supported currently
- Data only flows from Inventor to Fusion 360
- Data isn't immediately updated in Fusion 360 when a save is made in Inventor
  - initiate the desired update from model browser command
- Assembly data is derived into a single Fusion 360 component with no assembly joints
- Not all Inventor data is ported across – i.e assembly materials, iProperties (part numbers etc.)





Metal Additive Manufacturing

What is it?

Why are companies using it?

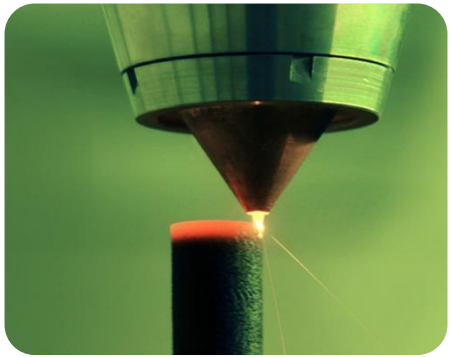
What is Metal Additive Manufacturing?

Common Metal Manufacturing Technologies

Casting

Forging

Machining



Additive

Why Metal AM?

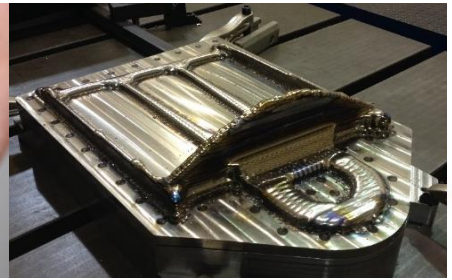
Marine

Aerospace

Automotive

Oil and Gas

Heavy Industry



Sustainability

Shorter production lead times

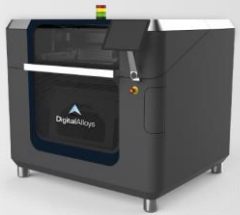
Reduced material waste and spare parts

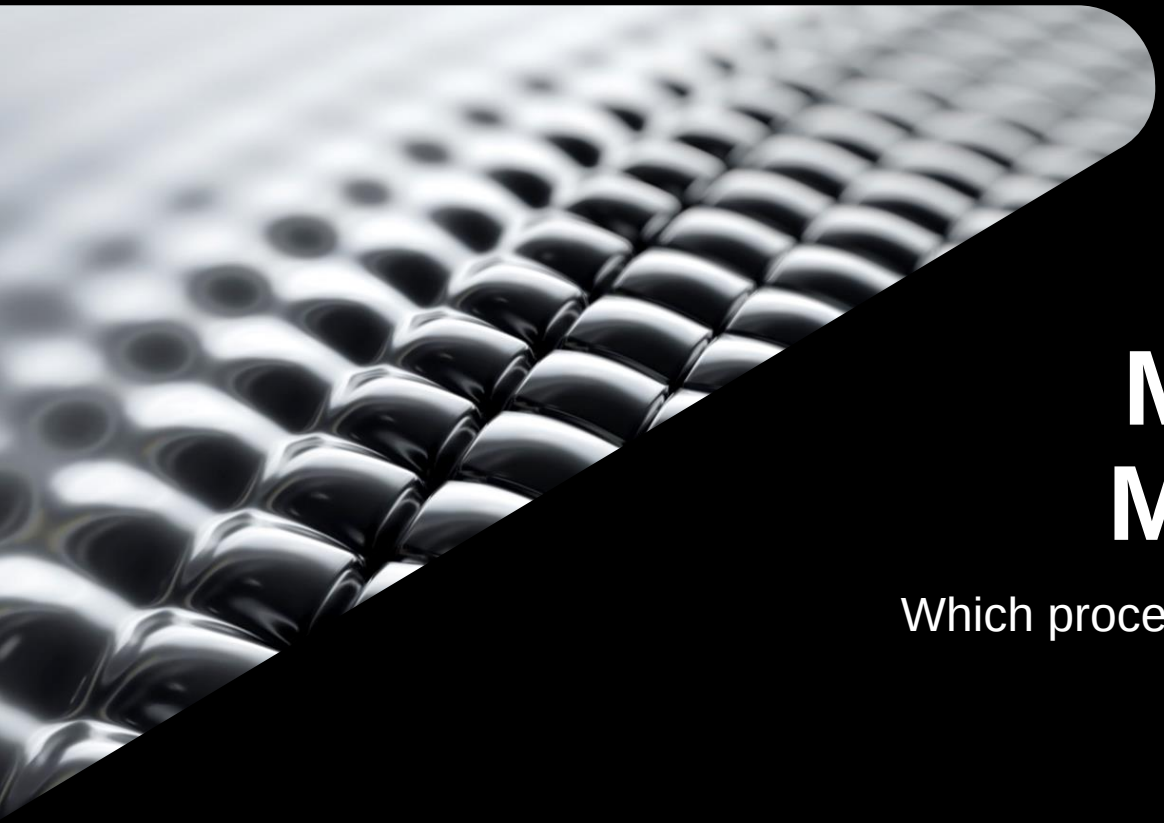
Improved part performance

De-centralised manufacturing

Why Metal AM?

Changing Industry Trends





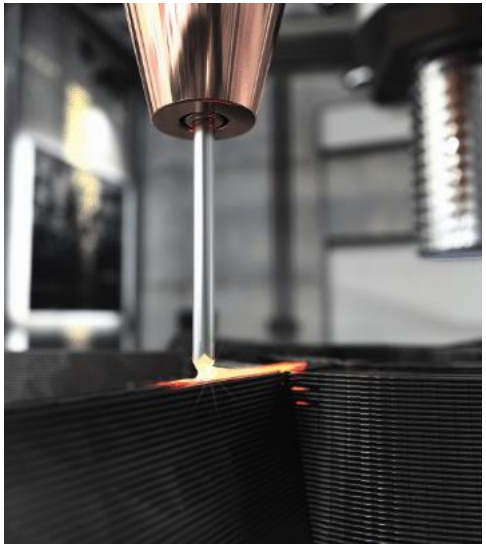
Metal Additive Manufacturing

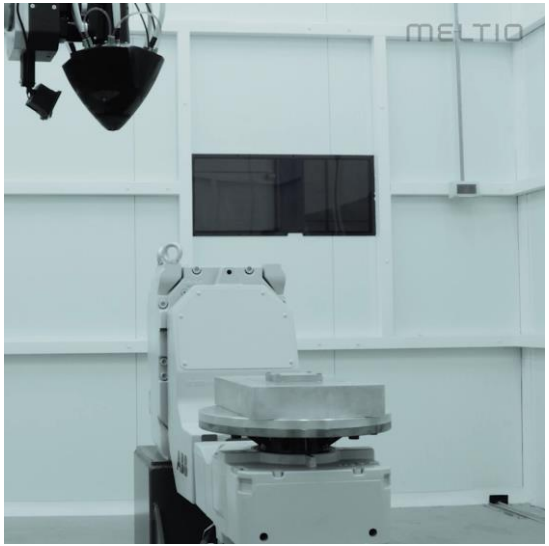
Which processes does Fusion 360 Support?

Metal AM Technology

Directed Energy Deposition

Additive





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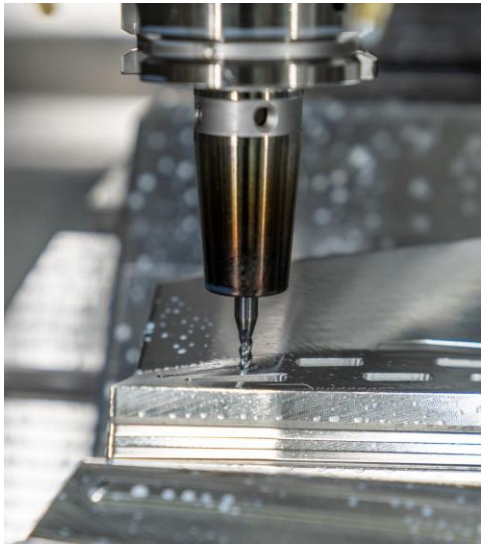
Subtractive

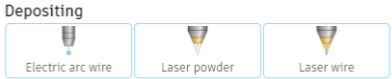


Hybrid

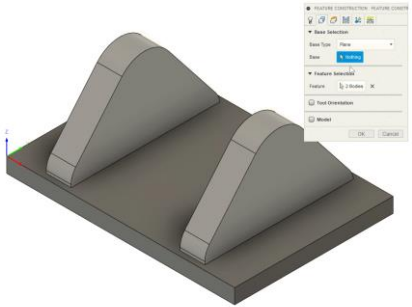
Multi-Axis Deposition Toolpaths in Fusion 360

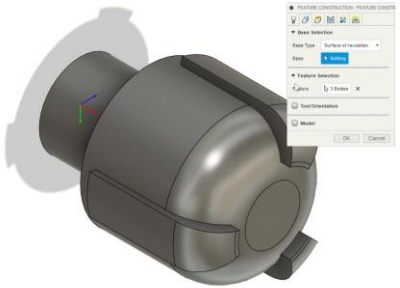
- Multi Axis Deposition Toolpaths – Tech preview released Nov. 2021

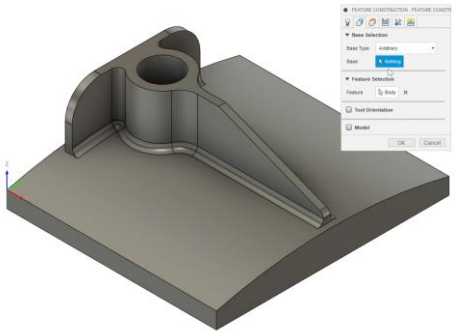
- Deposit entire components or add features to existing parts
- Create deposition conformal to planar, cylindrical, revolved or arbitrary surfaces
- Supports all major DED technologies

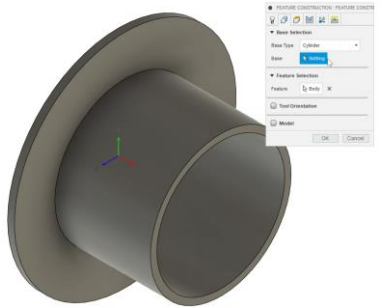


- Pass deposited stock forward to subsequent milling process
- Program milling toolpath with Fusion 360 suite of advanced milling toolpaths
- Post process additive and subtractive toolpaths into a single NC program



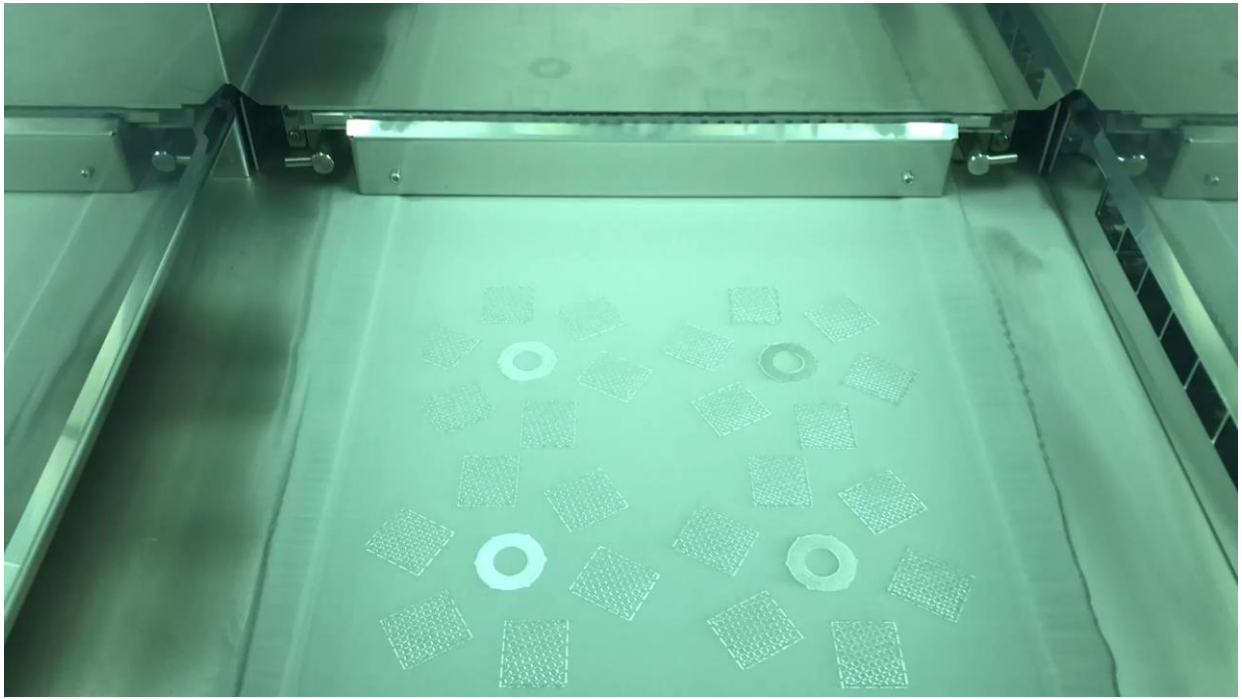






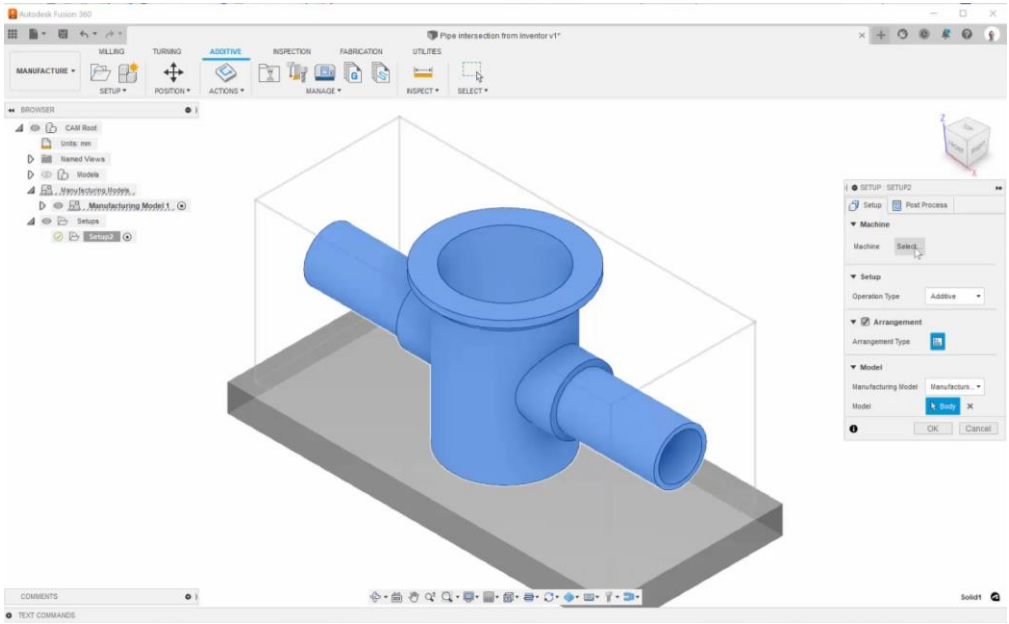
Metal AM Technology

Metal Powder Bed Fusion



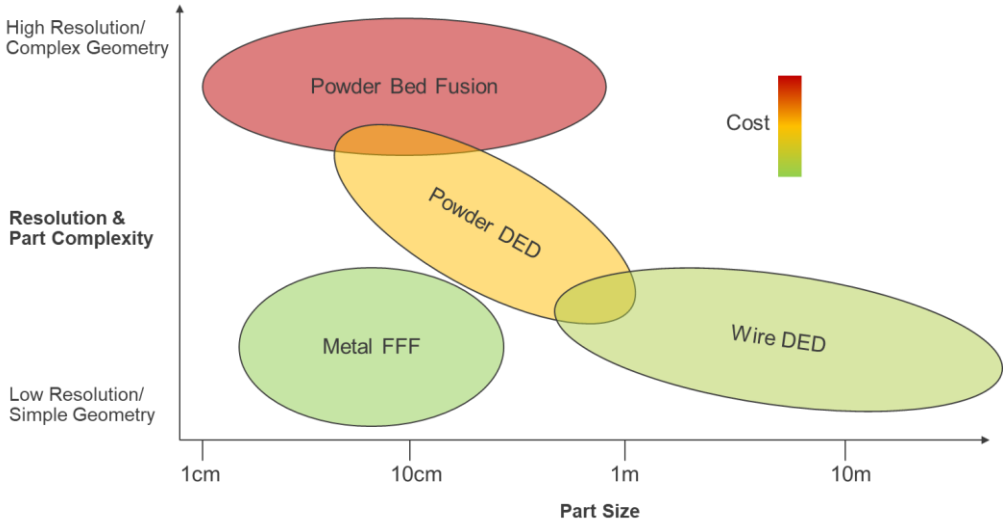
Metal Powder Bed Fusion in Fusion 360

- Select from a range of MPBF machine from all major manufacturers
- Apply material specific print settings
- Part orientation study
- Arrange components onto the build plate
- Generate support structures
- Slice and generate machine files*



*specific machines only

Comparison of Metal AM Technologies



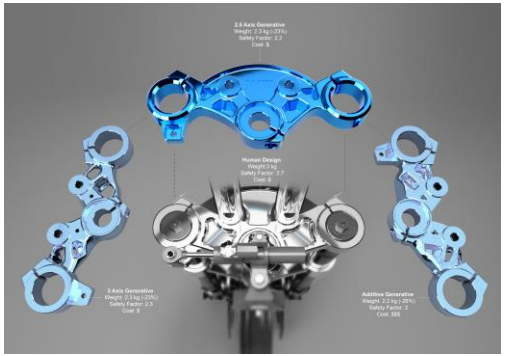
Additional advantages of DED

- Multi axis deposition overcomes the needs for support structures
- Ability to use multiple materials
- Feature addition to existing stock

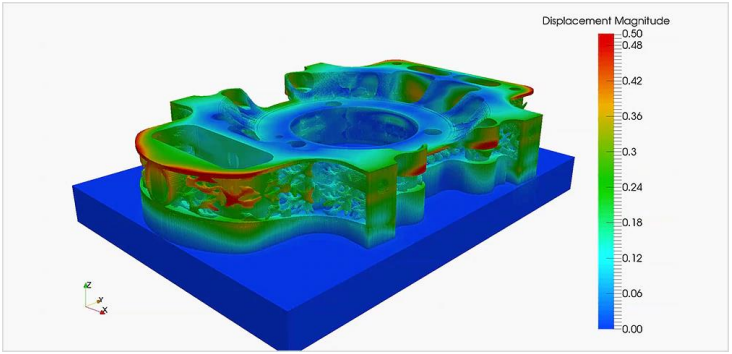
Inventor to Fusion 360

What's made Possible with Fusion 360 – Design and Simulation Tools for AM

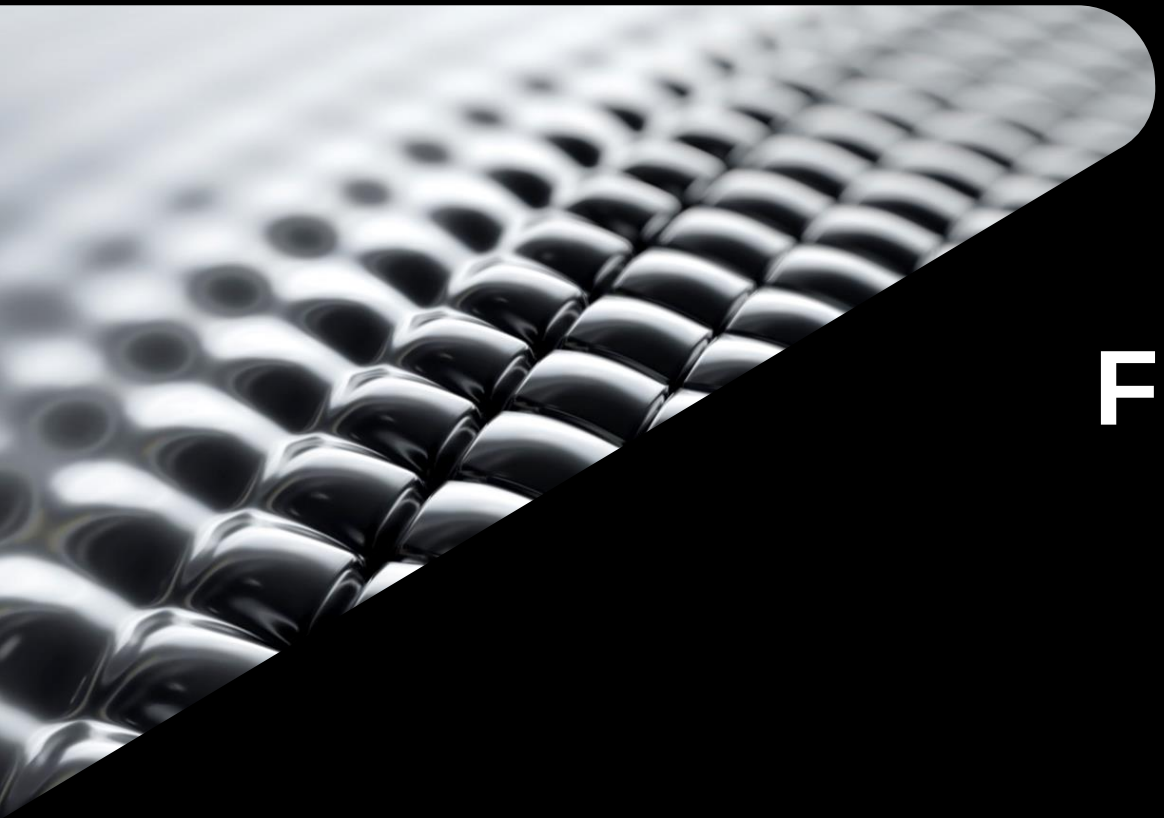
Volumetric Lattice



Generative Design



Metal AM Process Simulation



Inventor to Fusion 360 AM Use Cases

Unverferth

Unverferth Use Case

Who are Unverferth?

- Family-owned manufacturer of agricultural equipment for nearly 75 years
- Innovating with the help of, and for the farmer, to assist them in efficiently and responsibly feeding the world
- Collaborating with Autodesk for over 30 years
- Website - www.Unverferth.com

Unverferth®
Manufacturing Company, Inc.

Unverferth Use Case

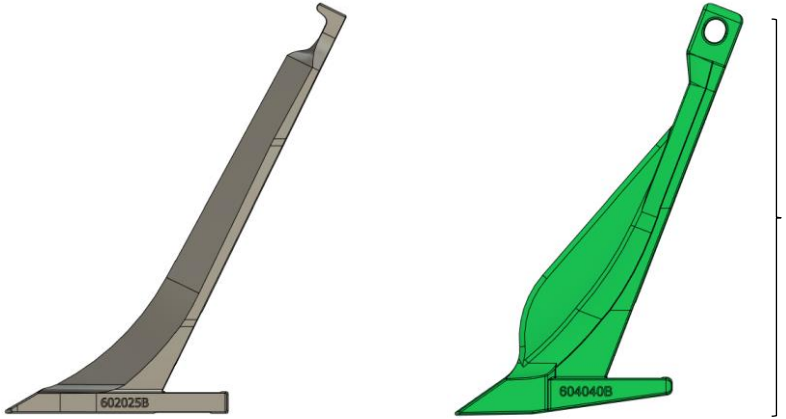
Why Additive Manufacturing?

- Metal Additive Manufacturing is progressing rapidly and getting more affordable
- Hybrid AM is very intriguing to us:
  - Uses weld wire which we already have and is readily available
  - Doesn't have the dust and environmental hazards of a powder type machine
- If we're not doing AM work we have an extra machine center that could be used to make production parts - helps the ROI of the hybrid machine
- Currently we envision 2 potential uses:
  - **Prototyping new cast or forge part designs** without having to invest in Expensive Tooling with a very short turn around time which allows our design to evolve quicker.
  - **Low Volume Service Parts** – Most Ag Equipment has quite long lifespans which could cover decades. For those older machines that need a service part that we may only sell a few pieces a year, it's attractive to create it with AM or a Hybrid method. This would eliminate the need to keep, set up and maintain multiple fixtures or pieces of tooling to produce that low volume. Same for Cast/Forged parts where very low volumes are not economically viable especially with current sourcing environment.

Unverferth Use Case

The Component

- Injection knife
- Traditionally cast
- Material
  - Conventionally hardened steel
  - AM part in 316L Stainless
- Manufacturing requirements
  - Deposited surface finish all over
  - Machined bore and slot
- Challenges
  - Machining hard to reach slot
  - Tall component may have distortion issues

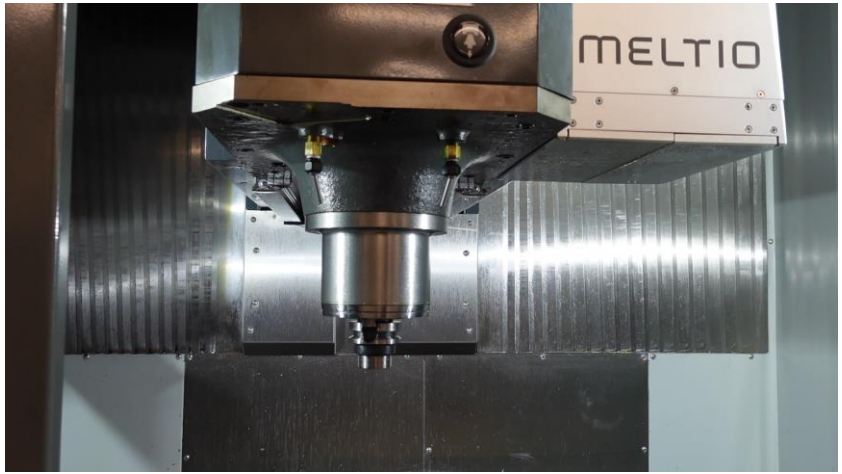


Conventional

Re-design

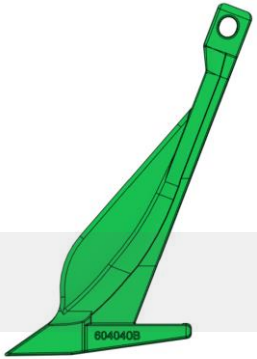
Unverferth Use Case

Manufacturing Process – Haas UMC1000 with Meltio Deposition Technology

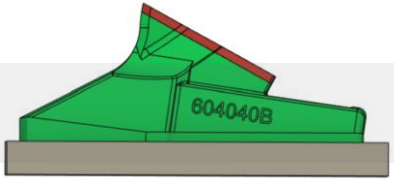


Unverferth Use Case

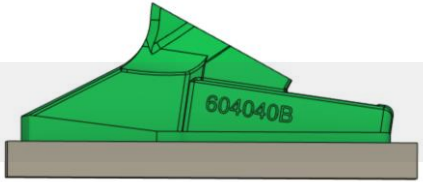
Manufacturing Process Planning



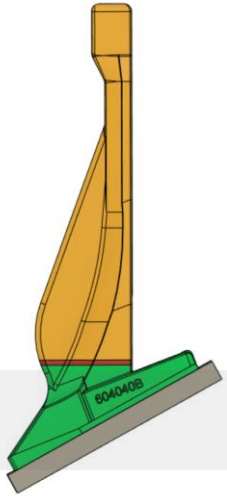
Original design



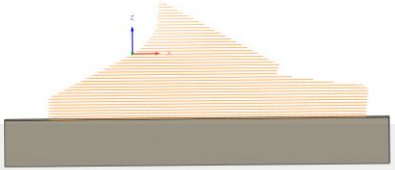
First Stage Additive



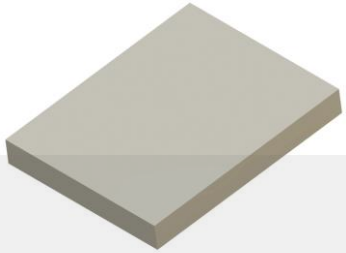
Re-qualify surface

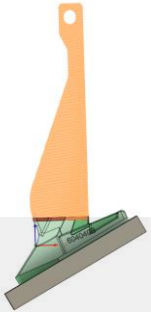


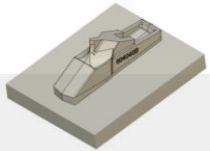
Second Stage Additive



First Stage Toolpath



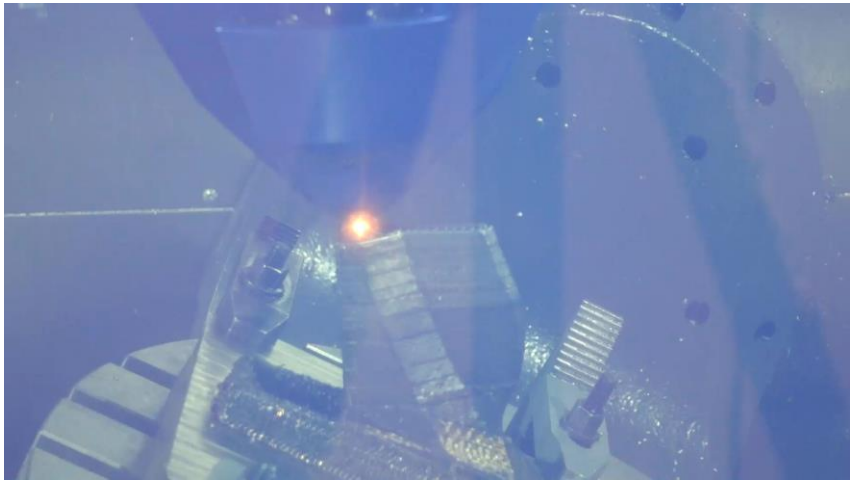


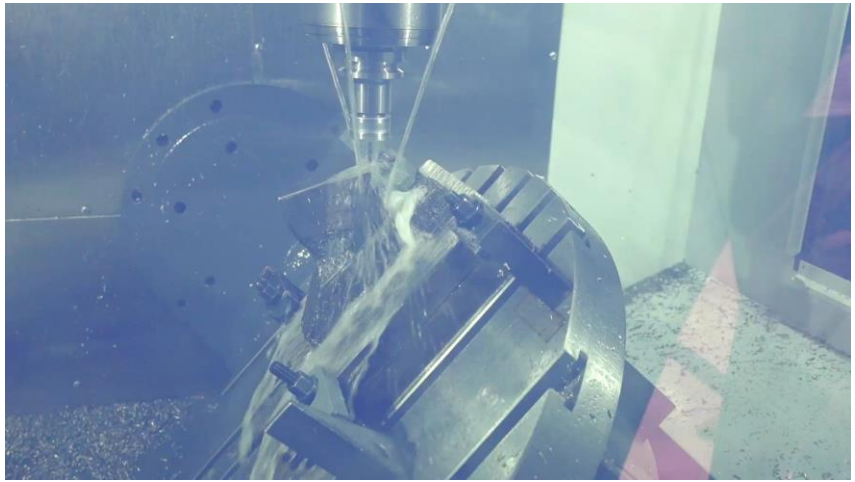


Second Stage Toolpath

Unverferth Use Case

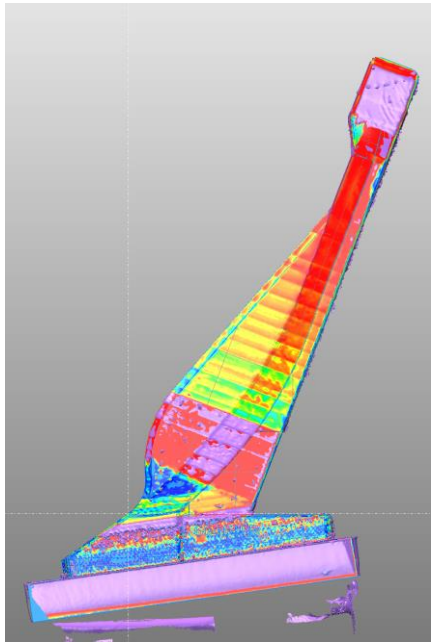
Manufacturing Process





Unverferth Use Case

Manufacturing Process – Final Part & 3D Scan



Unverferth Use Case

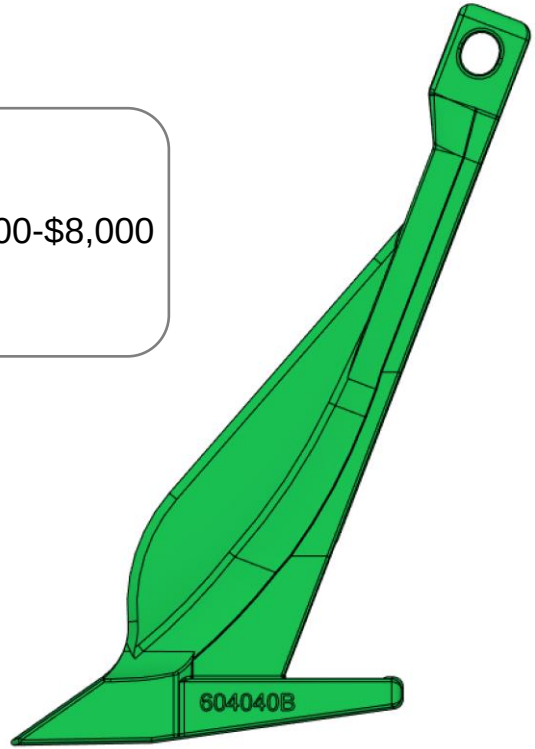
Process Time and Cost

DED Hybrid	
Build Time	15hrs
Cost	$612.52
Material	$46.75
Energy	$11.79
Gas	$25.43
Machine	$528.55

Casting

Cost of tooling: $6,000-$8,000

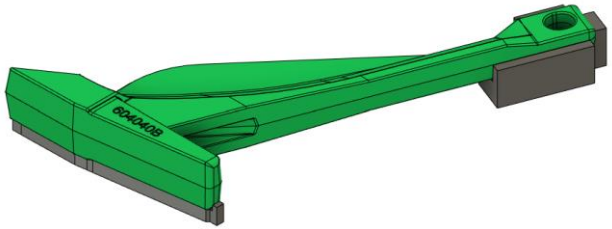
Lead time: 8-10wks

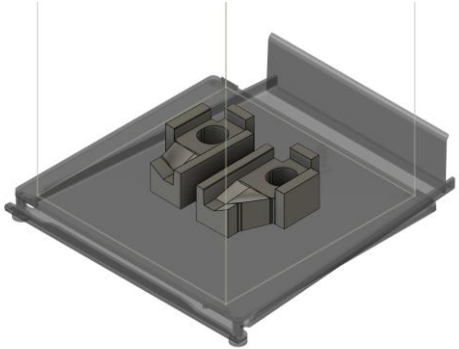


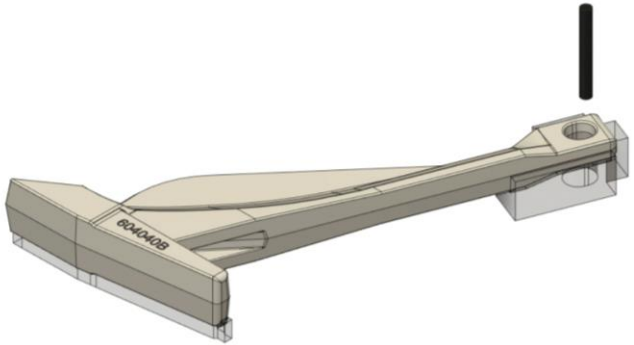
Unverferth Use Case

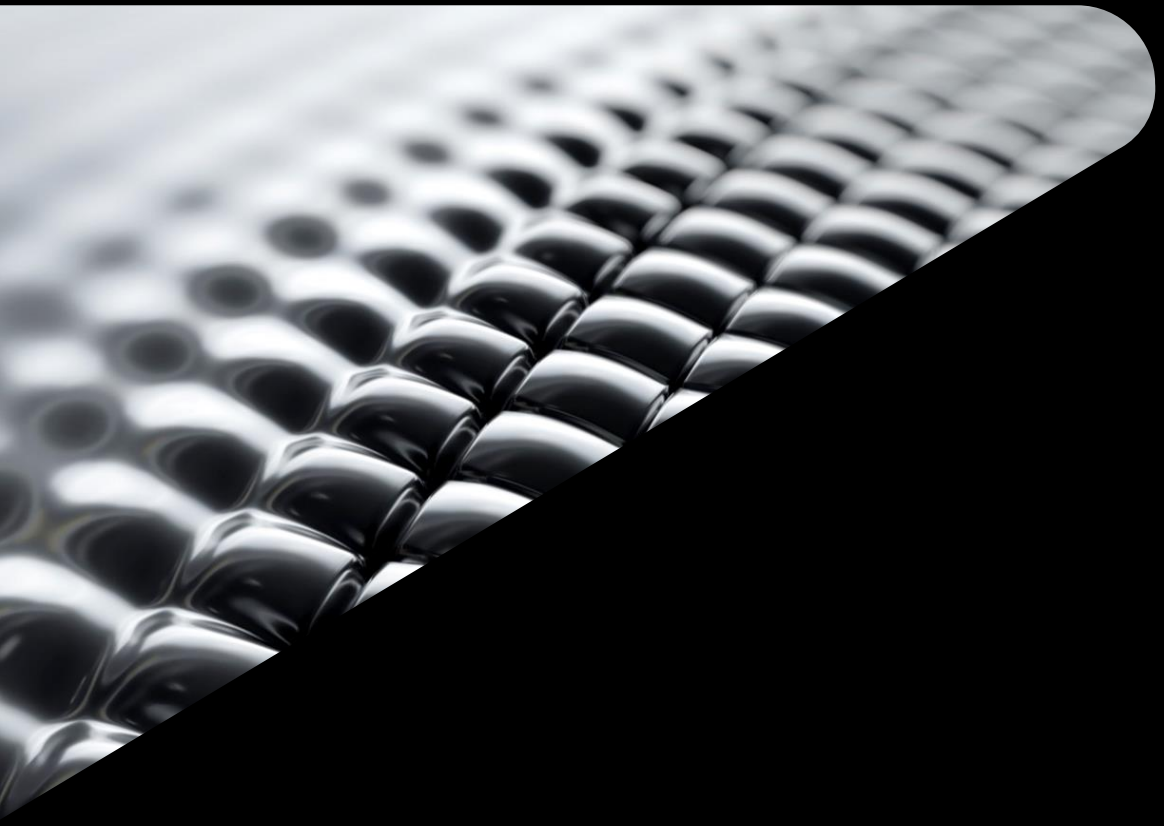
What's Next?

- Finish machining bore and foot
- Part testing with Unverferth
- Future components









Closing Remarks

Closing Remarks

- Why use the Inventor to Fusion 360 workflow?
  - Additional design, simulation and manufacturing capability
  - Collaboration across organizations
  - Communication – written, media sharing, progress updates
  - Data sharing – CAD, drawings, media
  - Inventor customers – don’t miss out on all this additional capability!
- Metal AM technologies are becoming more accessible
- Are you interested in working with us to explore metal Additive Manufacturing?
- More from these use cases to be released

Other Inventor to Fusion 360 Talks

- How Grumpy Sloth Created a Mechanical Keyboard with Inventor and Autodesk Fusion 360 (Scott Moyse)
- Collaboration Between Inventor and Autodesk Fusion 360 Within Vault Professional Environments (Andreas-Ernst Wagner)
- Generative Design for Inventor Users (Alessandro Gasso)

Q&A