Democratising DED in the Supply Chain

Robert Bowerman, Technical Consultant, Autodesk

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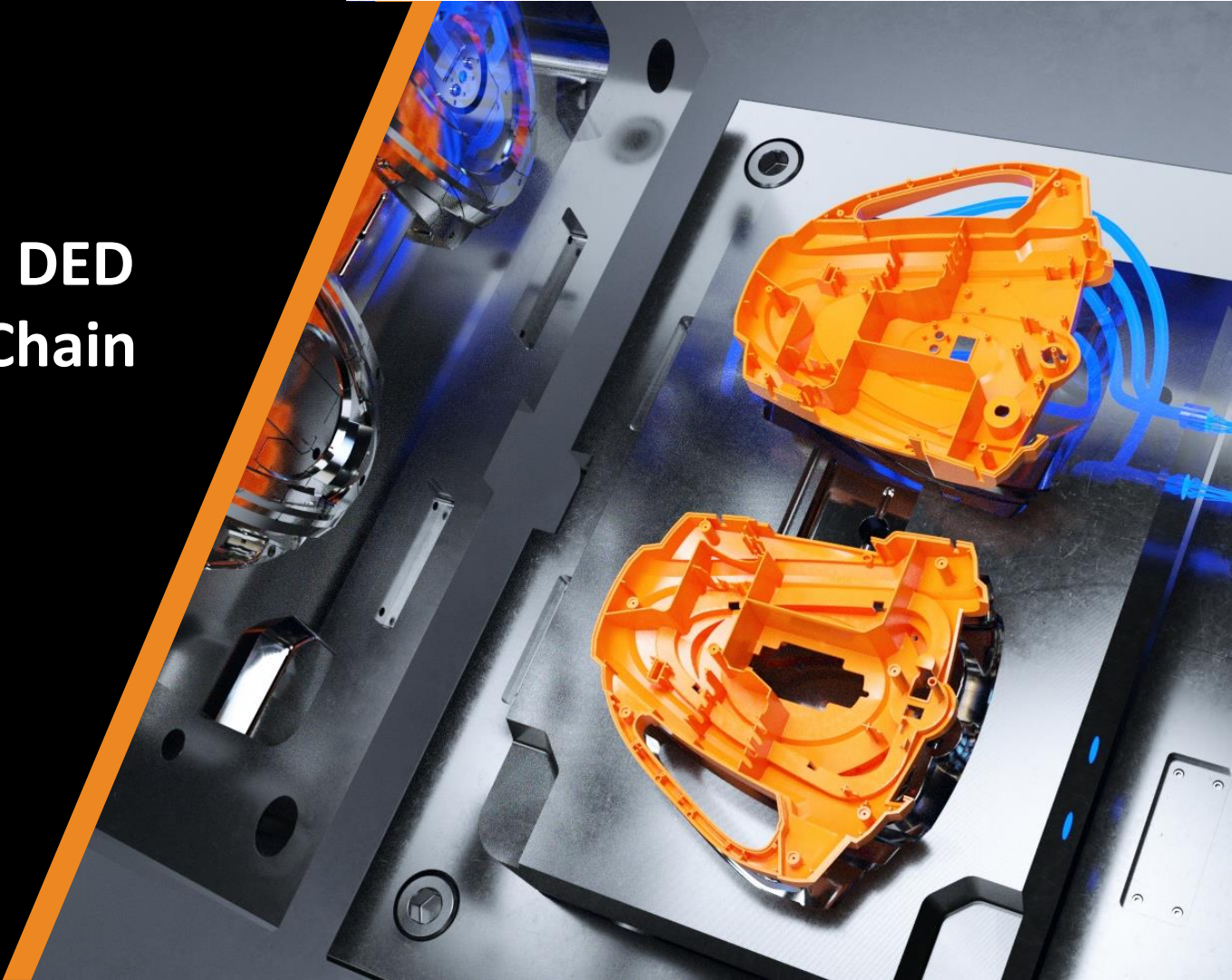

SPEAKER BIO

Robert Bowerman

A Technical 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.

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robert-bowerman

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Technology variants

Metal AM comparisons

DED Today

Who – industries involved

Why – business case

What – products being made

How – specific machines

Barriers

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4 pillars of adoption

What are Autodesk doing?

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Introduction To DED

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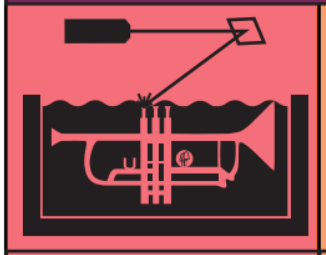
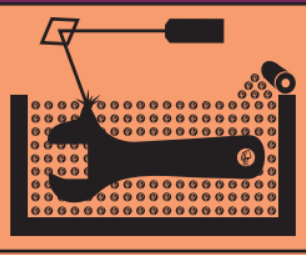
7 Families of Additive Manufacturing

According to ASTM F2792 Standards



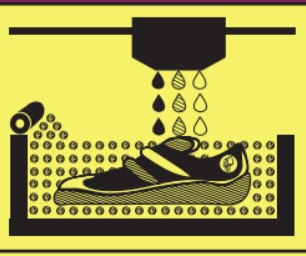
VAT Photopolymerization

Alternative Names:
SLA™ - Stereolithography Apparatus
DLP™ - Digital Light Processing
3SP™ - Scan, Spin, and Selectively Photocure
CLIP™ – Continuous Liquid Interface Production



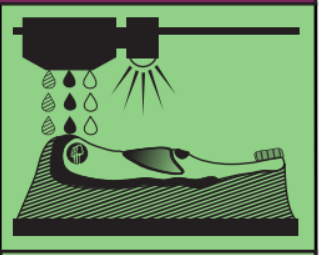
Powder Bed Fusion (PBF)

Alternative Names:
SLS™ - Selective Laser Sintering; DMLS™ - Direct Metal Laser Sintering; SLM™ - Selective Laser Melting: EBM™ - Electron Beam Melting; SHS™ - Selective Heat Sintering; MJF™ - Multi-Jet Fusion



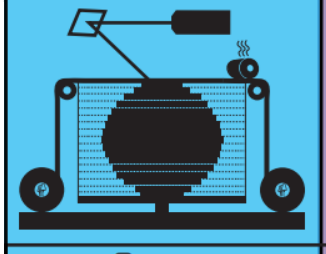
Binder Jetting

Alternative Names:
3DP™ - 3D Printing
ExOne
Voxeljet



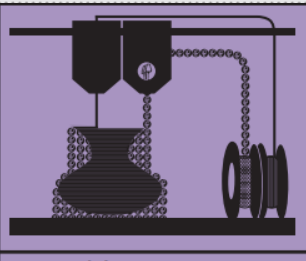
Material Jetting

Alternative Names:
Polyjet™
SCP™ - Smooth Curvatures Printing
MJM - Multi-Jet Modeling
Projet™



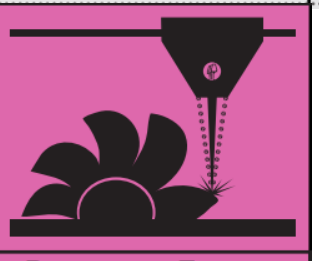
Sheet Lamination

Alternative Names:
LOM - Laminated Object Manufacture
SDL - Selective Deposition Lamination
UAM - Ultrasonic Additive Manufacturing



Material Extrusion

Alternative Names:
FFF - Fused Filament Fabrication
FDM™ - Fused Deposition Modeling



Directed Energy Deposition (DED)

Alternative Names:
LMD - Laser Metal Deposition
LENS™ - Laser Engineered Net Shaping
DMD™ - Direct Metal Deposition

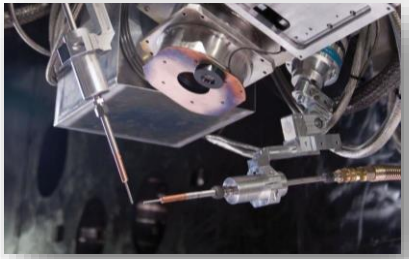
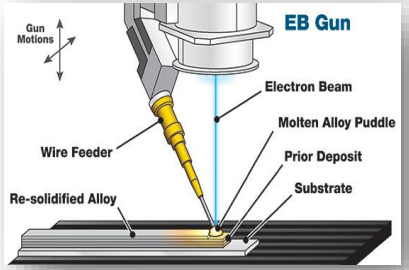
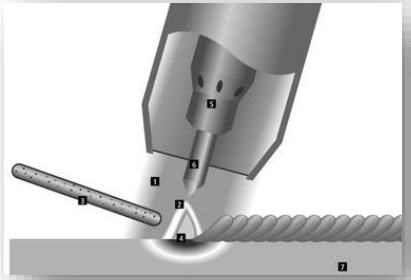
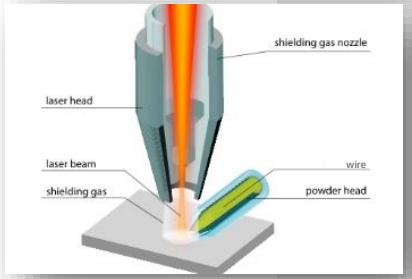
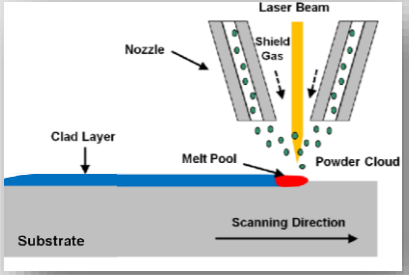
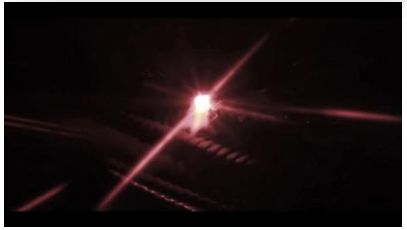
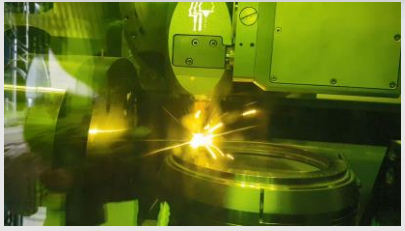
Image courtesy of Hybrid Manufacturing Technologies

ADDITIVE MANUFACTURING TECHNOLOGIES

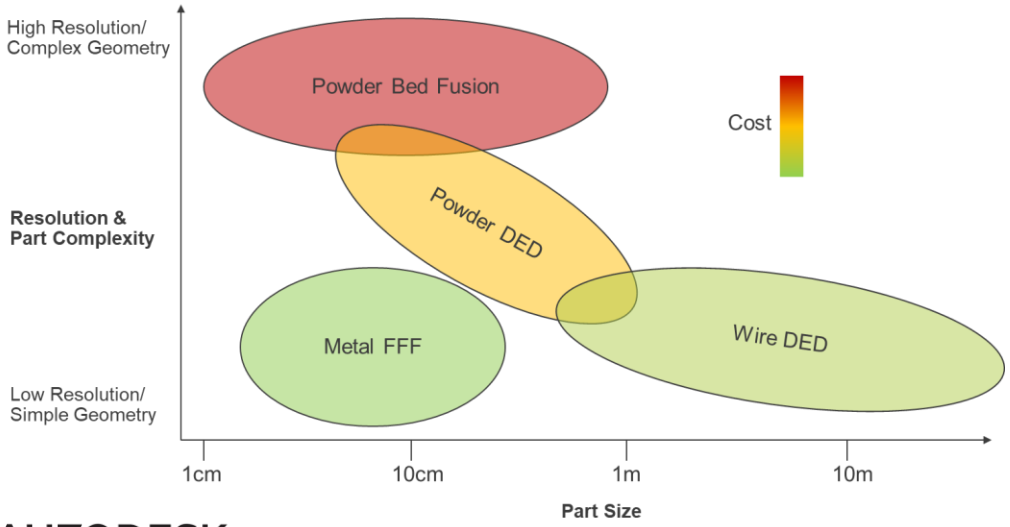
Find out more at **www.3dhubs.com/what-is-3d-printing**

3D HUBS

Process

EBM + Wire	Arc + Wire	Laser + Wire	Laser + Powder
			
			
			

Comparing Metal AM Technologies



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Multi axis deposition overcomes the needs for support structures

Ability to use multiple materials

Feature addition to existing stock

DED Today

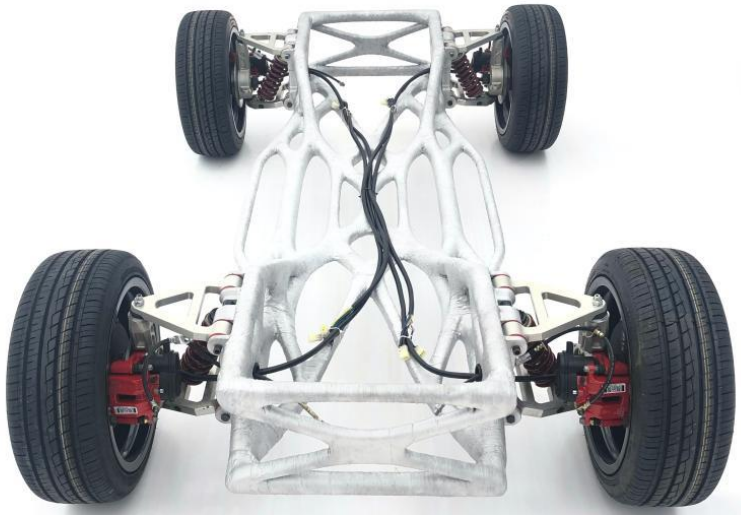
Who – industries involved

Why – business case

What – products being made

How – specific machines

Barriers



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Why DED?

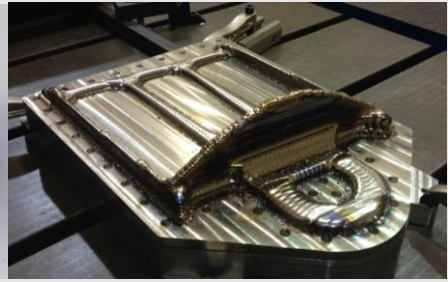
Marine

Aerospace

Automotive

Oil and Gas

Heavy Industry



Sustainability

Shorter production lead times

Reduced material waste and spare parts

Improved part performance

De-centralised manufacturing

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Source: Norsk Titanium

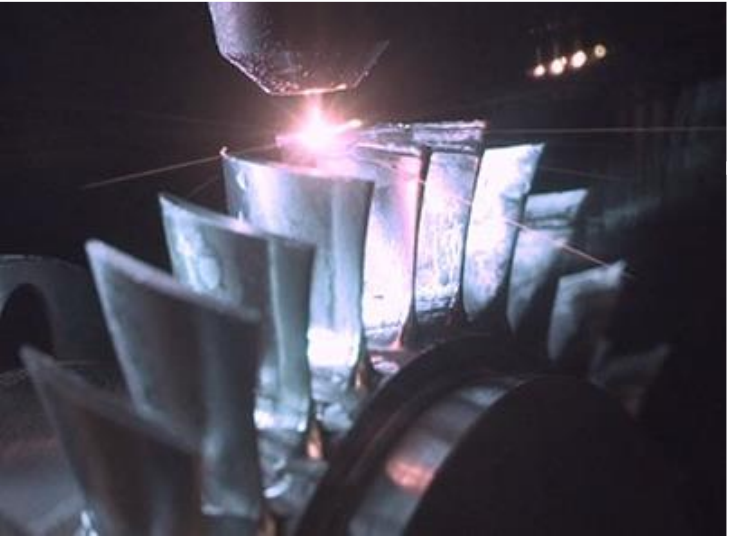
Source: Cranfield University

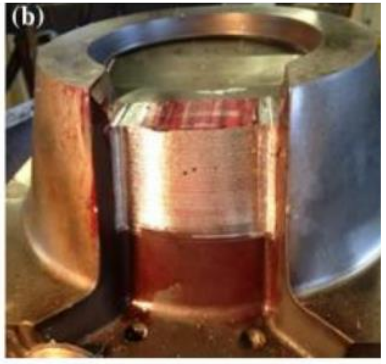
Source: Naval group

Source: Sciaky

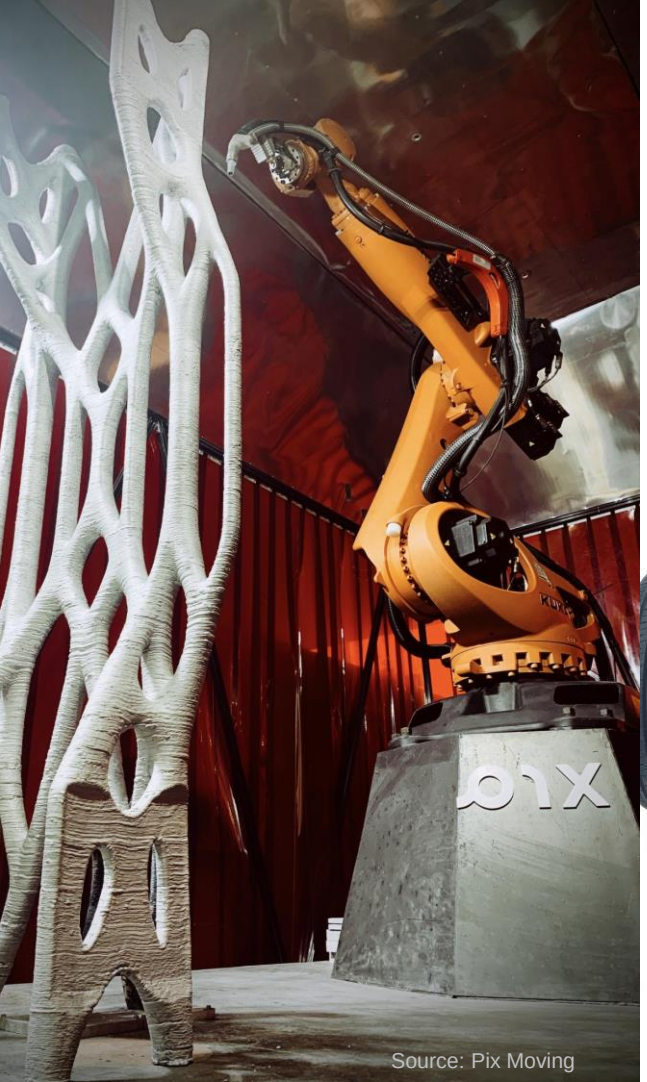
Source: Sciaky

valk

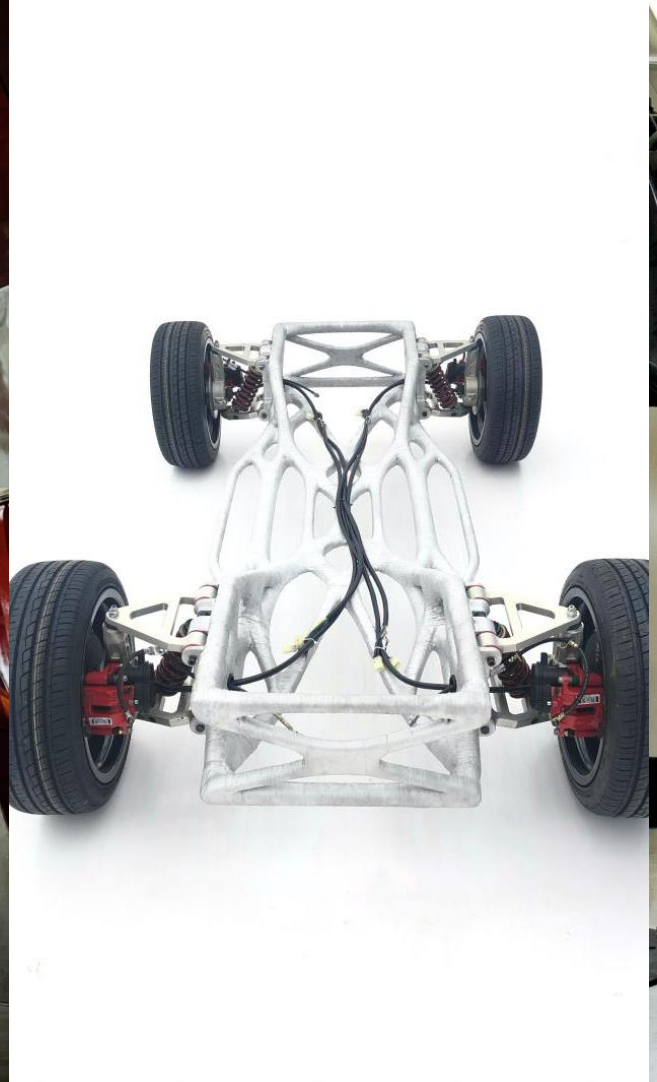



(b)

Source: Naval group
NAVALNEWS



Source: Pix Moving



Source: Relativity Space

LASERTEC 65 3D hybrid

+GF+

ABB

Mazak
SMOOTH
HYBRID
VC-500AM

LOADING ZONE

Mazak

FORM ALLOY
L221

LASER SYSTEMS
557
RPM

Barriers

Incomplete and fragmented software workflows

Process requires expert knowledge

Limited materials know-how

Qualification of parts

Expensive hardware

Lack of turnkey solutions

Few real life examples

Lack of standards

Failure to scale

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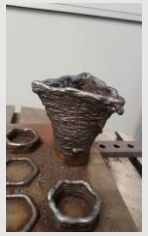
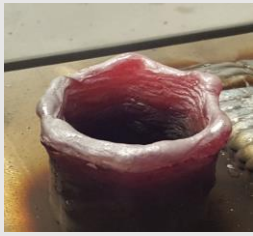
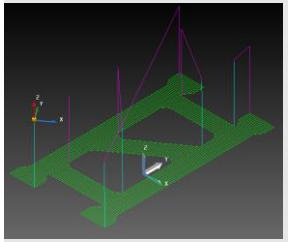






$$$

Driving Adoption

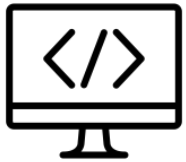
How might industry gain access to DED…?

To achieve scale we must drive its adoption down the supply chain

To enable adoption we must overcome the current barriers

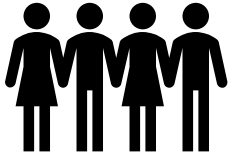
Hardware

Work with and enable low-cost machines



Software

Accessible integrated workflows



People

Tools that reduce specialist knowledge

Processes

Ability to achieve a first-time right build

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Hardware

Work with and enable low-cost machines

- Accessible
- Repeatable
- Reliable
- Standards

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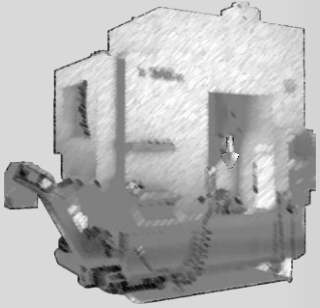
Meltio

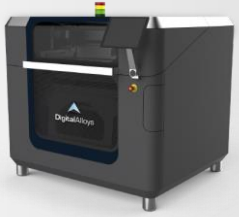
ABB



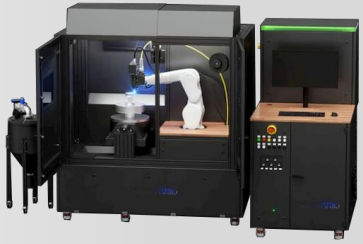
Low cost hybrid

DMG Mori

BeAM



Digital Alloys



Aconity3D

Mazak

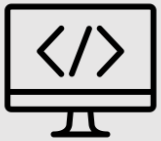
$

$ $ $

Software

Accessible integrated workflows

- Accessible
- Ease of use
- Integrated
- Connected



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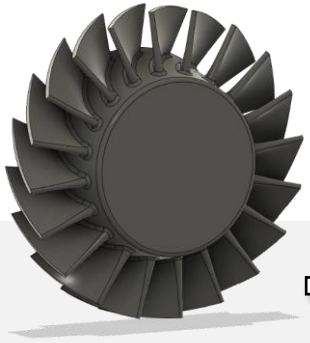
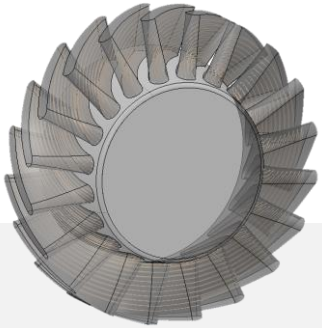
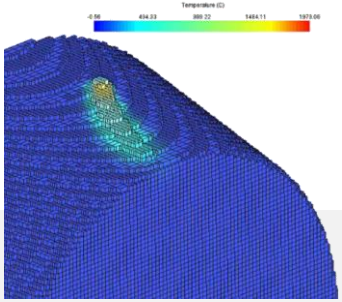


Part design

Design for manufacture



Toolpath Planning



Process Simulation

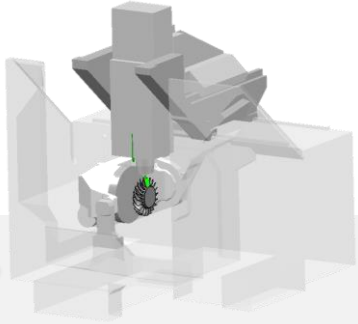
AUTODESK® FUSION 360™

AUTODESK® INVENTOR®

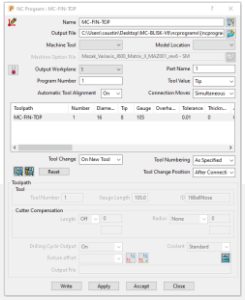
AUTODESK® POWERSHAPE®

AUTODESK® POWERMILL®

AUTODESK® NETFABB®



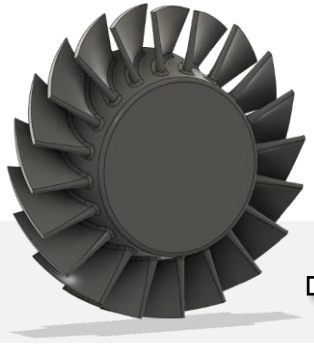
Machine Simulation



NC Creation

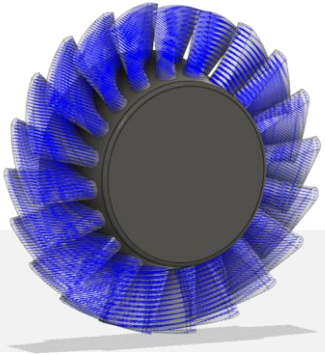
Machine Connection

Manufacture

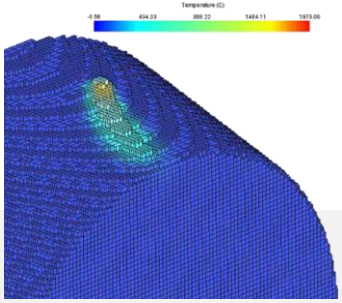


Part design

Design for manufacture



Toolpath Planning



Process Simulation

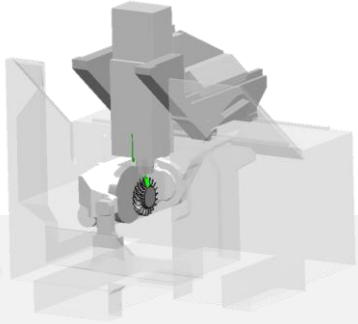
Accessible

Ease of use

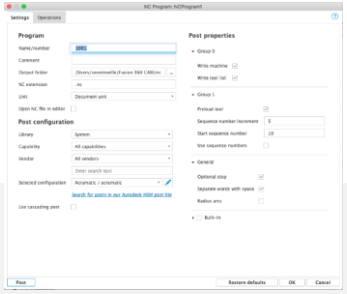
AUTODESK®
FUSION 360™

Integrated

Connected



Machine Simulation



NC Creation

Machine Connection

Manufacture

People

Tools that reduce specialist knowledge

- Ability to upskill yourself
- Accessible content and courses
- Community of users
- Access to experts

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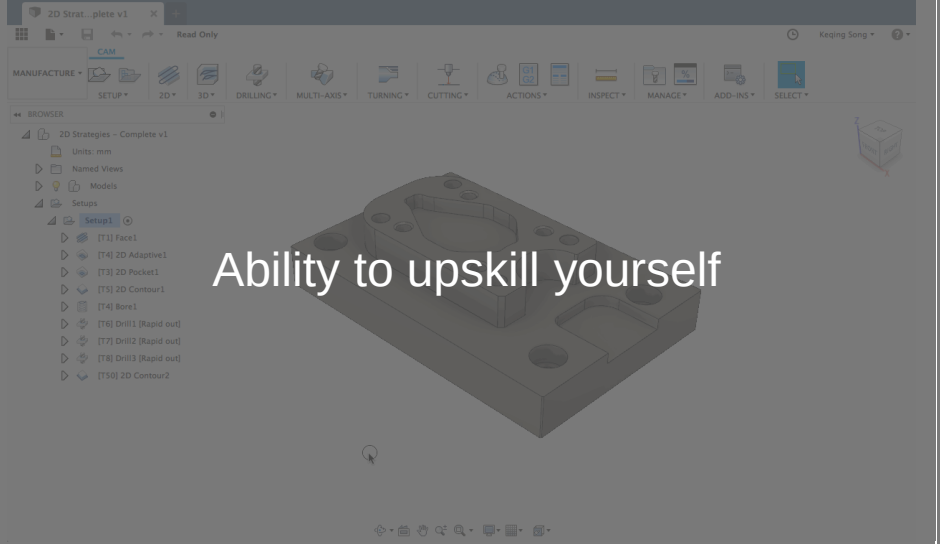


Ability to upskill yourself

Training programs:

EWI

EWF

Cranfield University

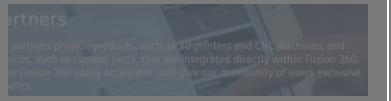
mtc Manufacturing Technology Centre

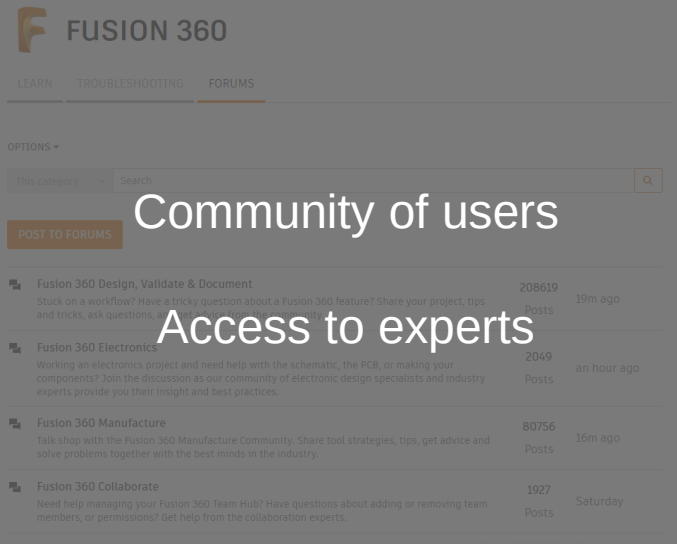
America Makes

Accessible content and courses

Autodesk partners:

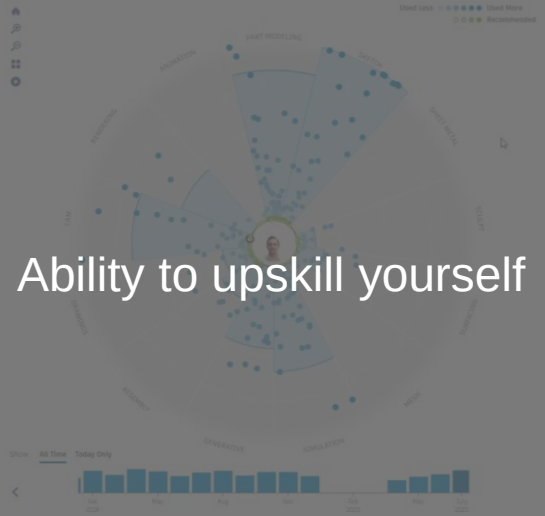
AUTODESK Authorized Training Center





Community of users

Access to experts



Ability to upskill yourself

Process

Ability to achieve a first-time right build

- Where do I start?
- Will it work?
- How did it go?
- Standards
- Repeatable
- Reliable

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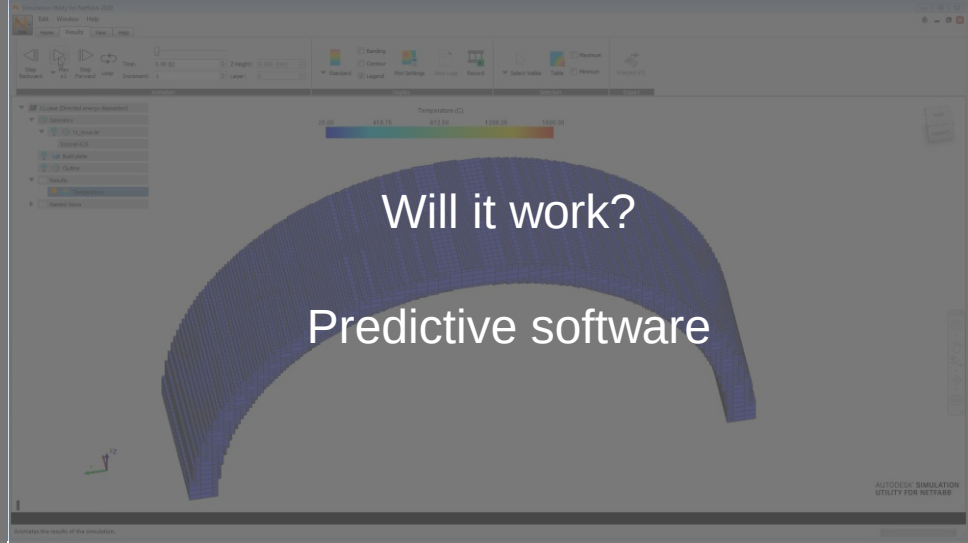
Where do I start?

Embedding knowledge into software and having access to parameters



Will it work?

Predictive software

How did it go?

Store and learn from experience

What is best practice?

Develop standards

Barriers

How could this group help?

Incomplete and fragmented software workflows

Process requires expert knowledge

Limited materials know-how

Qualification of parts

Expensive hardware

Lack of turnkey solutions

Few real life examples

Lack of standards

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How is Your Work Contributing?

Incomplete and fragmented software workflows

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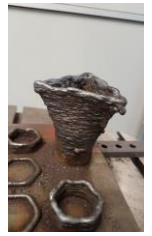

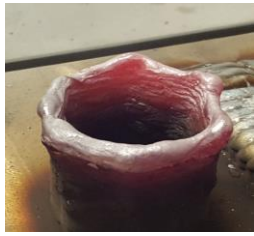

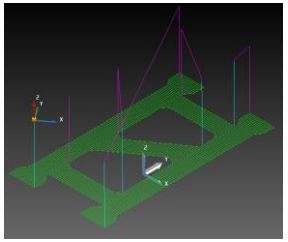

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Summary

Realise the benefits of DED by driving adoption down the supply chain

Four key pillars identified to scale the technology

Collaboration is key and no one can scale this technology on their own

Please reach out!

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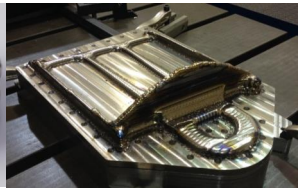
Sustainability

Shorter production lead times

Reduced material waste and spare parts

Improved part performance

De-centralised manufacturing



Hardware
Work with and enable low cost machines

People
Tools that reduce specialist knowledge

Software
Accessible integrated workflows

Processes
Ability to achieve a first-time right build

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