Industrial 3D Printing
Debunking the Myths

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Industrial 3D Printing - Debunking the Myths

The use of 3D printing, or additive manufacturing, continues to evolve at unprecedented levels, making it a challenge to distinguish between the hype and the reality of the technology. Mainstream media often highlights the extreme stories targeted at capturing the public's attention, which only adds to the difficulty of knowing the true capabilities of the technology. The use of additive manufacturing in industrial sectors, such as aerospace, medical, and automotive, is growing, validating the media's focus goes beyond just hype. However, application of additive is not without its challenges, which include the cost of a 3D printed part vs. traditional manufacturing as well as validation of a part manufactured in a new method. This session will debunk the myths of 3D printing, separating the hype versus the reality. Use cases studies, in both metals and polymers, of how industries have overcome the challenges, and are using additive manufacturing to positively impact business goals by supporting product development and support will be shared.

- Enabling rapid exploration of new concepts, and design changes without investment in expensive tooling
- Enabling product development teams to get engineering data and customer feedback early in the development cycle in a manner that is cost effective
- Identifying cost effective ways to support customers and products in the field.

Upon completion, participants will be able to

- identify opportunities where additive manufacturing can be applied to the product development process.
- identify opportunities where additive manufacturing can be applied to the product support process.
- understand how to apply additive manufacturing in a manner that is cost effective.

Agenda

- Who I Am
- Learning Objectives
- The Myths
- What's Next

Who I Am

- Chemical engineer from University of Cincinnati, Ohio, USA
- 30 years of produce & process design at Caterpillar Inc.
- Additive Manufacturing Product Manager at Caterpillar Inc.
- President of StaceyD Consulting, LLC
- Society of Women Engineers Past President

Learning Objectives

1. Identify opportunities where additive manufacturing can be applied to the product development process.
2. Identify opportunities where additive manufacturing can be applied to the product support process.
3. Understand how to apply additive manufacturing in a manner that is cost effective.

Industrial 3D Printing

- Early Adopters
  - Medical – customized implants, surgical tools, and assistance devices
  - Aerospace – savings in weight translate to less fuel
  - Consumer Products – customized products
- Emerging Adopters
  - Construction equipment
  - Mining equipment
  - Engines
  - Automotive
  - Military

Industrial applications

Industrial applications have unique value propositions based on the application

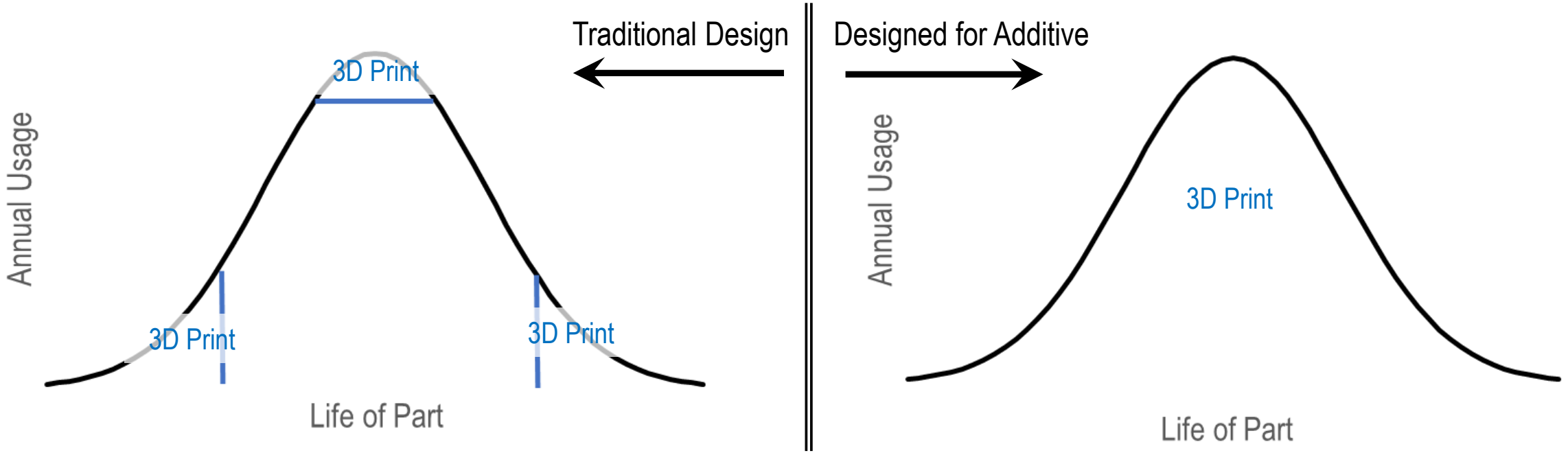
The Myths

1. We can't print anything OR
   We can print everything
2. Step #1 = buy a printer
3. The quality is not good enough quality
4. It's too expensive

Myth #1

We can't print anything OR
We can print everything

The answer is somewhere in the middle depending on the application and value



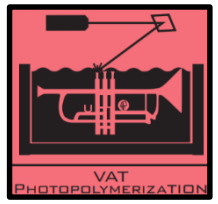
Myth #2
Step #1 = Buy a Printer

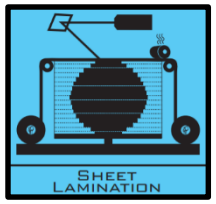
There's more to deploying 3D printing than just buying a printer

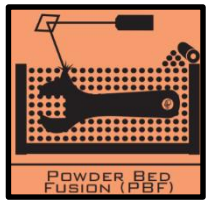
1. Develop a strategy
   - Why do you want to print
   - What do you want to print
2. Start designing for additive manufacturing
   - Host design competition to engage engineers
   - What materials do you need
3. Work with established suppliers to print
4. Then…look at what printer you might want to buy

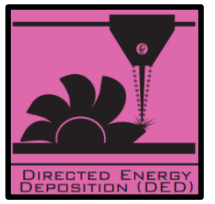
Strategy is Critical Before Buying a Printer

7 Additive Technologies – Numerous Material Options









	Material extrusion	Material jetting	Binder jetting	Vat photopoly-merization	Sheet lamination	Powder bed fusion	Directed energy deposition
Polymers, polymer blends	x	x	x	x	x[1]	x	
Composites[2]	x	x	x	x	x	x	
Metals	x	x	x		x	x	x
Graded/hybrid metals[3]					x		x
Ceramics	x	x	x	x		x	
Investment-casting patterns		x	x	x		x	
Sand molds and cores	x		x			x	
Paper/wood[4]	x				x		

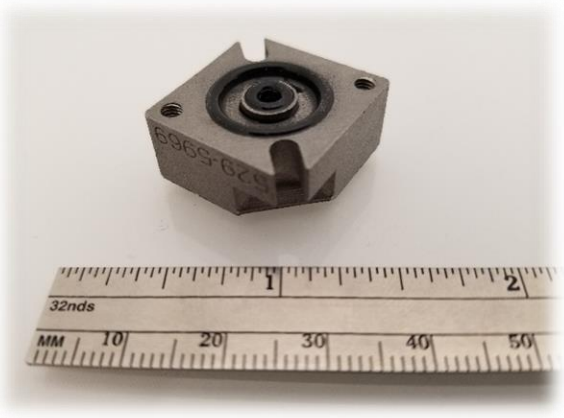
Source: Wohlers Associates, Inc.

Myth #3

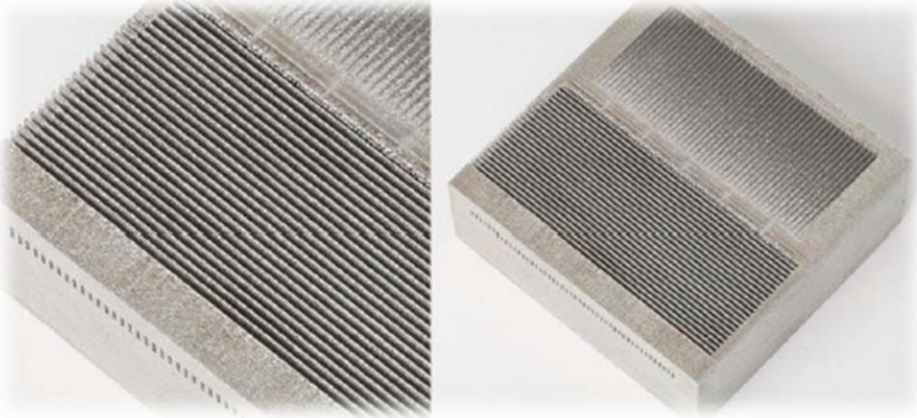
The quality is not good enough quality

Choosing the right application and process is critical

Gas turbine blades, Siemens



Heavy-duty truck suspension manifold, Caterpillar Inc.

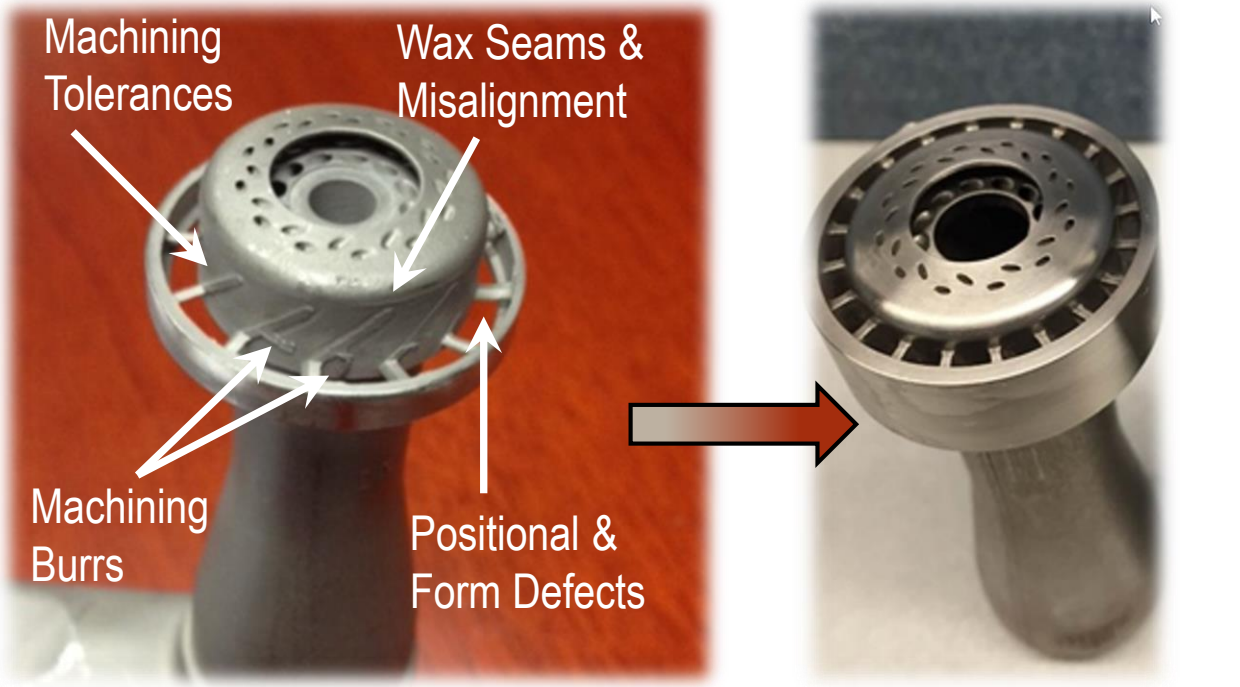


Heat exchanger design with progressive heat fins for optimal cooling, United Technologies

Gas Turbine Fuel Swirler, Solar Turbines

Goal: Eliminate Defects inherent to traditional casting & machining process

- Released to production in 2016
- Benefits for using Additive Manufacturing
  - Reduced development time: 85% faster
  - Cost reductions: 35%
  - Enabled redesign to achieve greater life and performance
  - Inspiration for development of additional production components



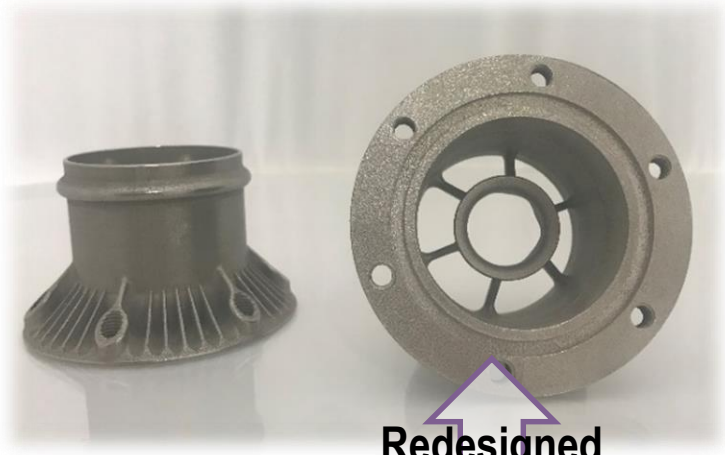
Original Casted

Re-designed 3D Printed

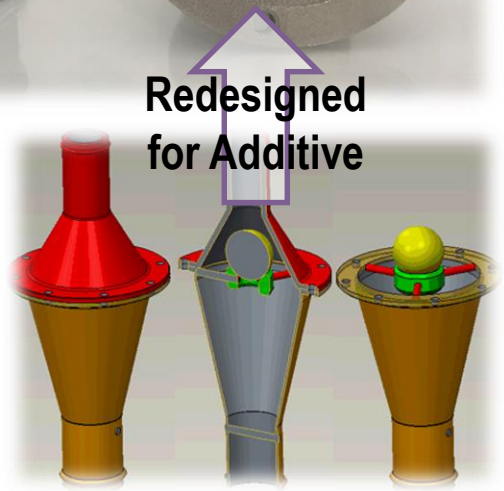
Myth #4
It's too expensive

Finding the right value proposition is key

Emergency Orders



Combining Parts in an Assembly



Low Volume Parts

Low Volume Parts

R-FAB: Rapid Fabrication via Additive Manufacturing on the Battlefield

- An expeditionary system containing ruggedized equipment/tools for additive manufacturing at the point of need
- Outcome: successfully demonstrated the viability of AM in expeditionary environments
  - "Jumped" 8 times
  - Produced parts in arid, dusty, and high humidity environments
  - 65 different parts and ~500 pieces of equipment in three
- Lessons Learned
  - Significantly improves readiness
  - Empowers soldiers to innovate
  - Augments the supply chain

Stacey (Minch) DelVecchio

Key Take Aways

- Choose the right application to print
- Develop your strategy before buying a printer
- Quality is acceptable with the right process and design
- Affordability is possible with the right value proposition