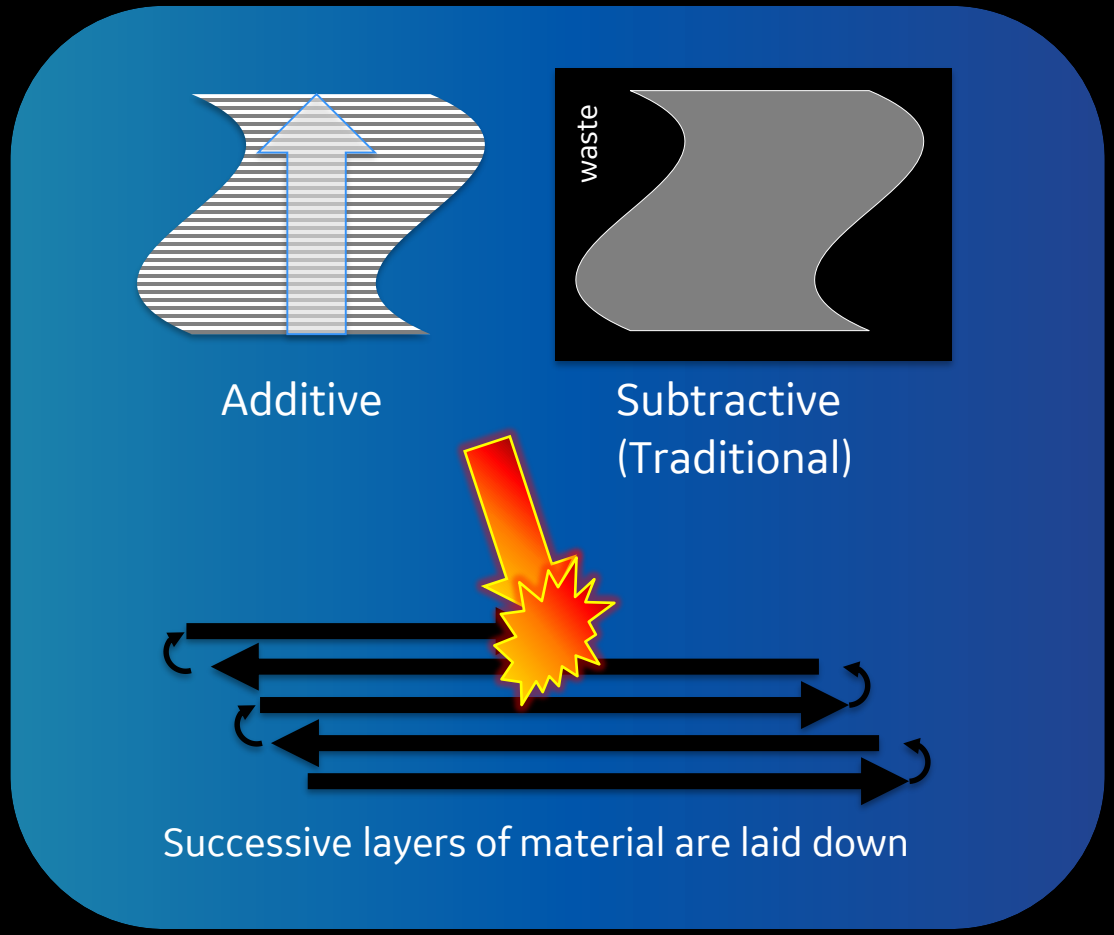
Technologies of the Future Additive Manufacturing

Marian Lubieniecki
EDC, GE Aviation
3 October 2017

What is Additive Manufacture (a.k.a. 3D Printing)

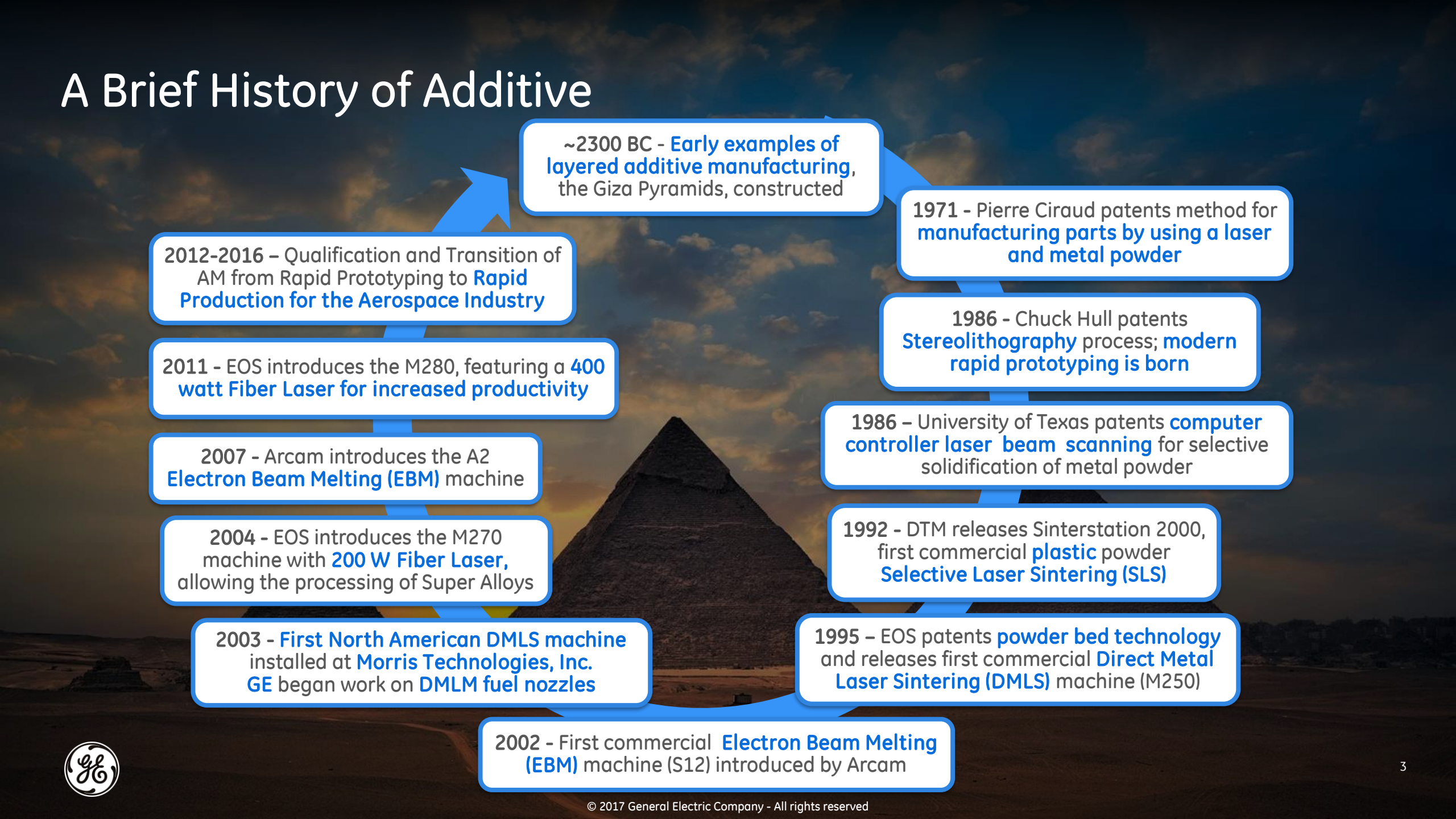


3D printing or additive manufacturing (AM)

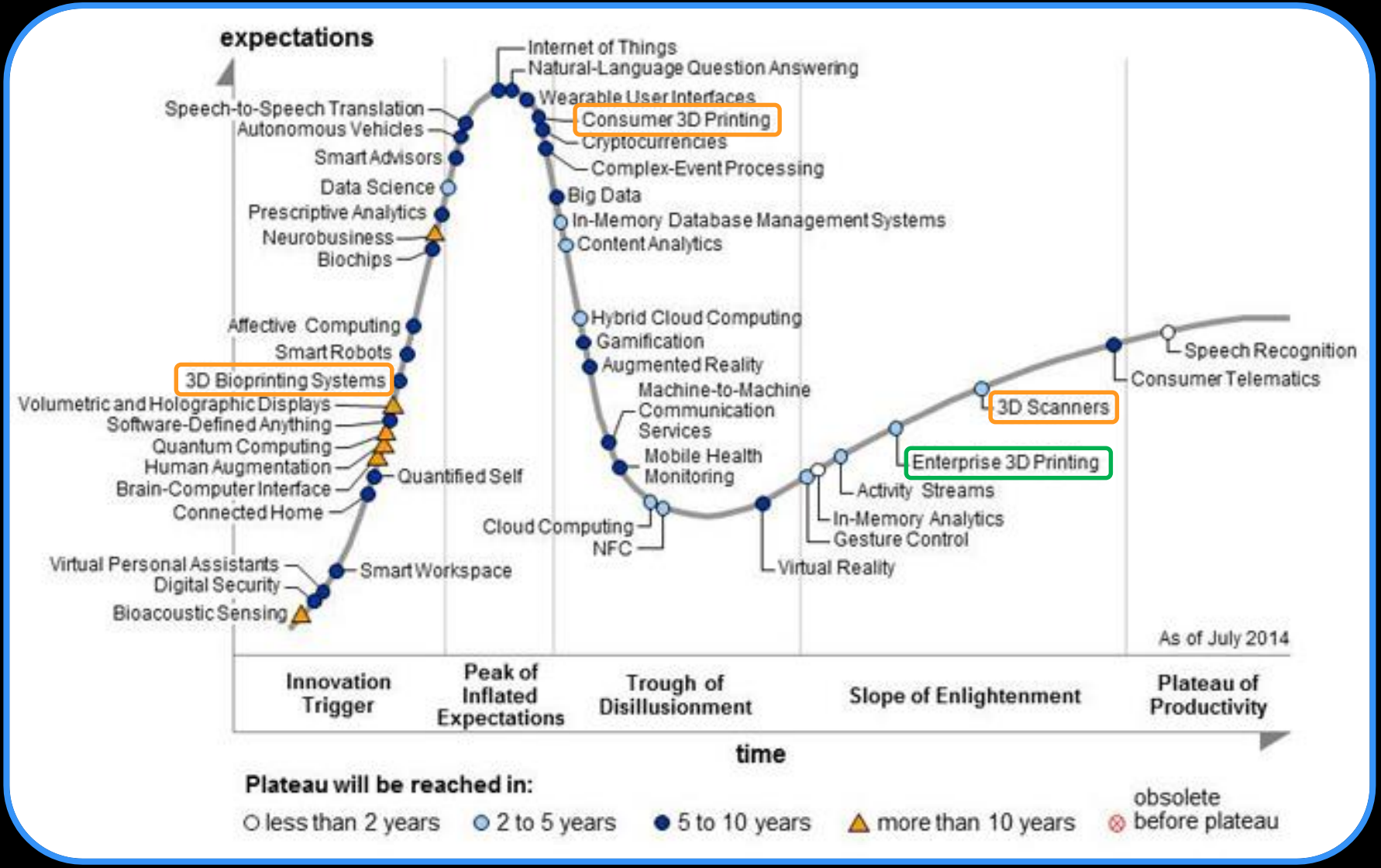
is any of various processes for making a three-dimensional object of almost any shape from a 3D model or other electronic data source primarily through additive processes in which successive layers of material are laid down under computer control.

- Wikipedia

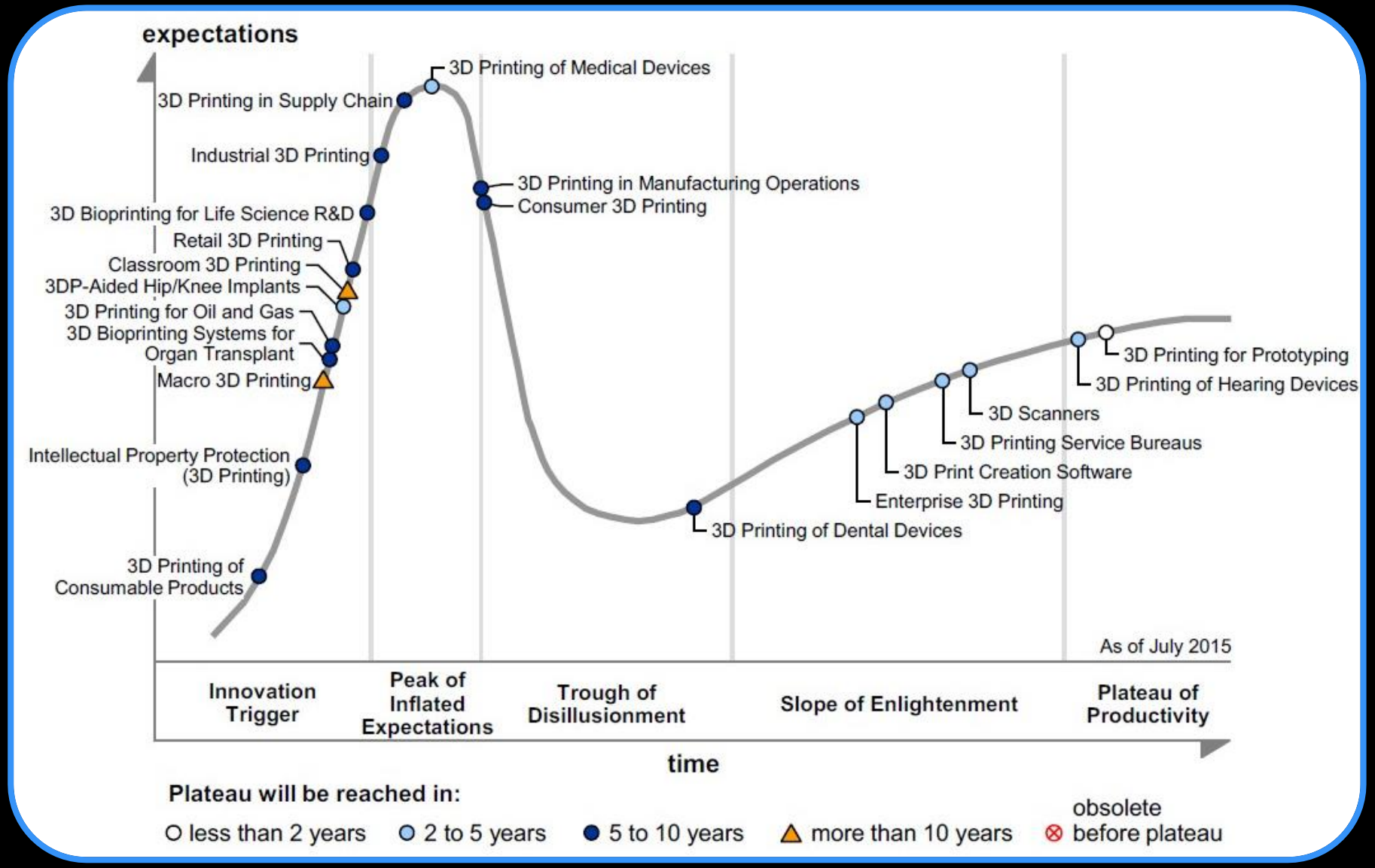
A Brief History of Additive



Gartner's Hype Cycle for Emerging Technologies

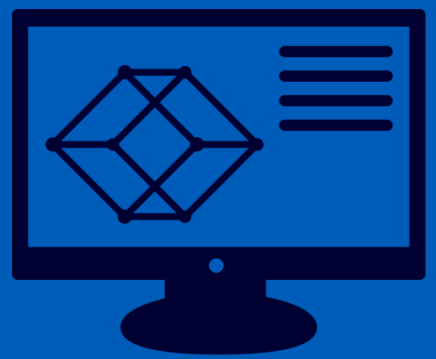


Gartner's Hype Cycle for 3D Printing



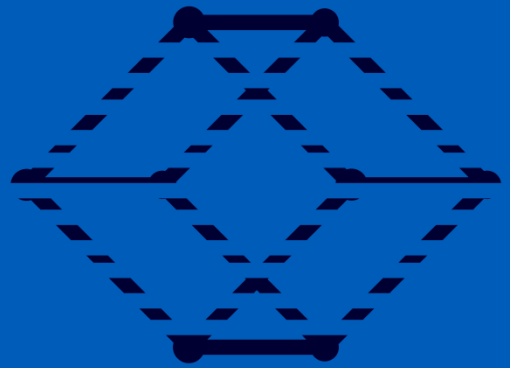
Additive Manufacturing … a 4 step process

Digital design



1

Digital slicing

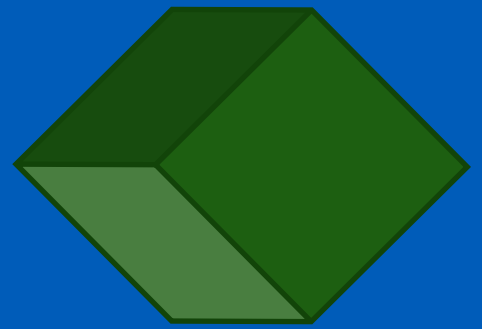


2

Layer-wise manufacturing

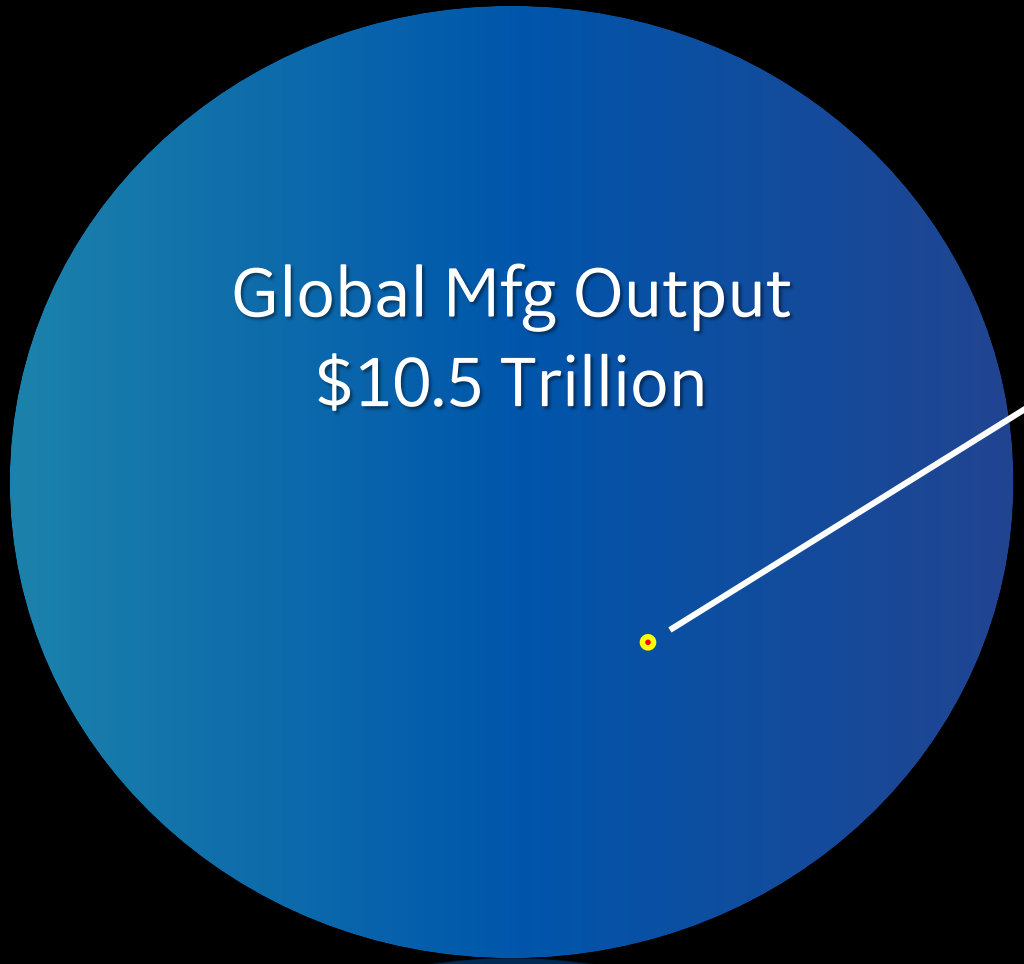
3

Final part



4

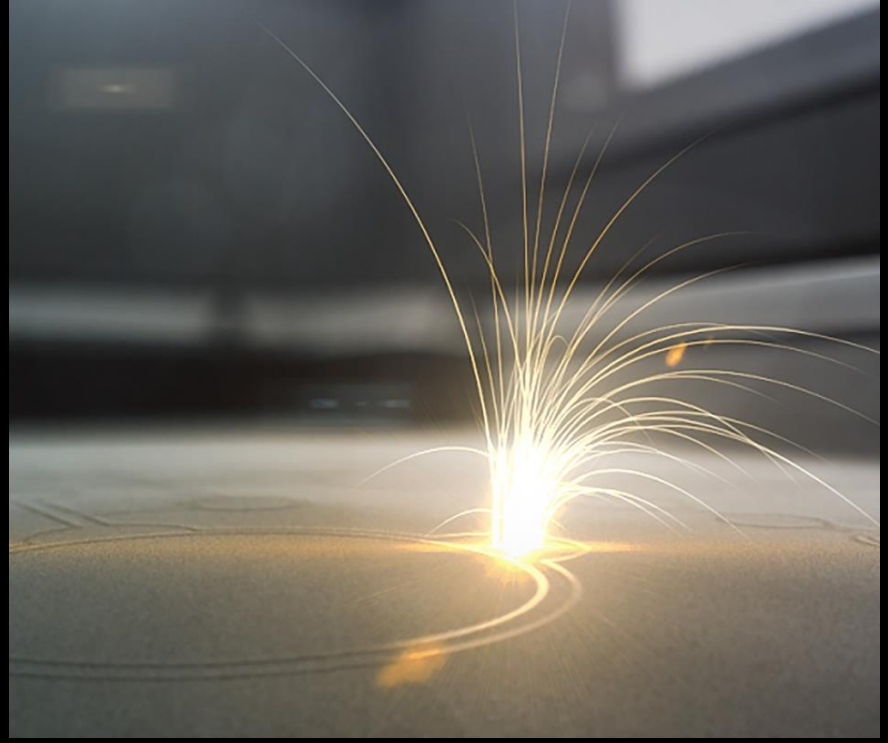
Additive Potential



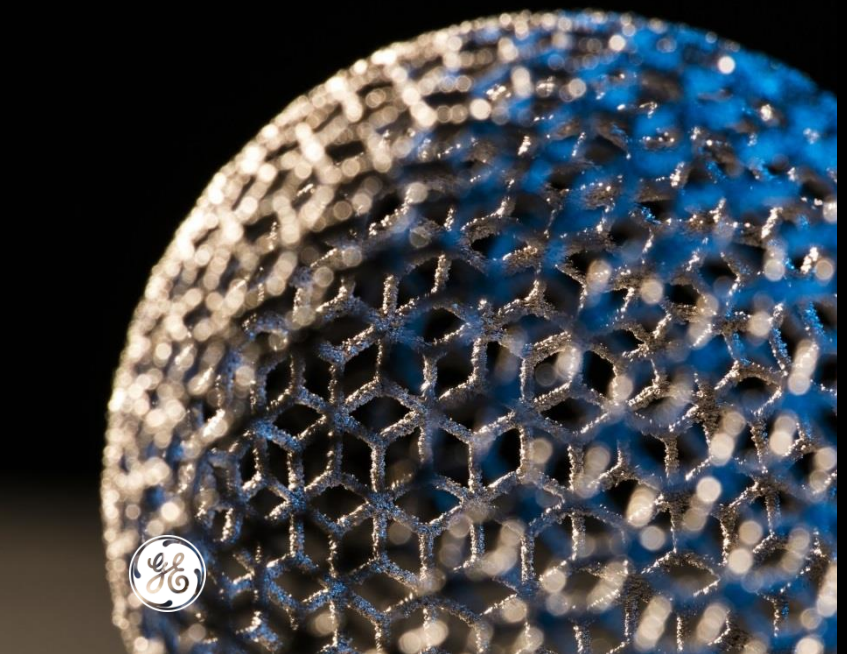
- $2.2 billion professional industrial additive market
- 0.02% of total global manufacturing output
- What if it was just 1%?
  = $100B!

Why Additive?

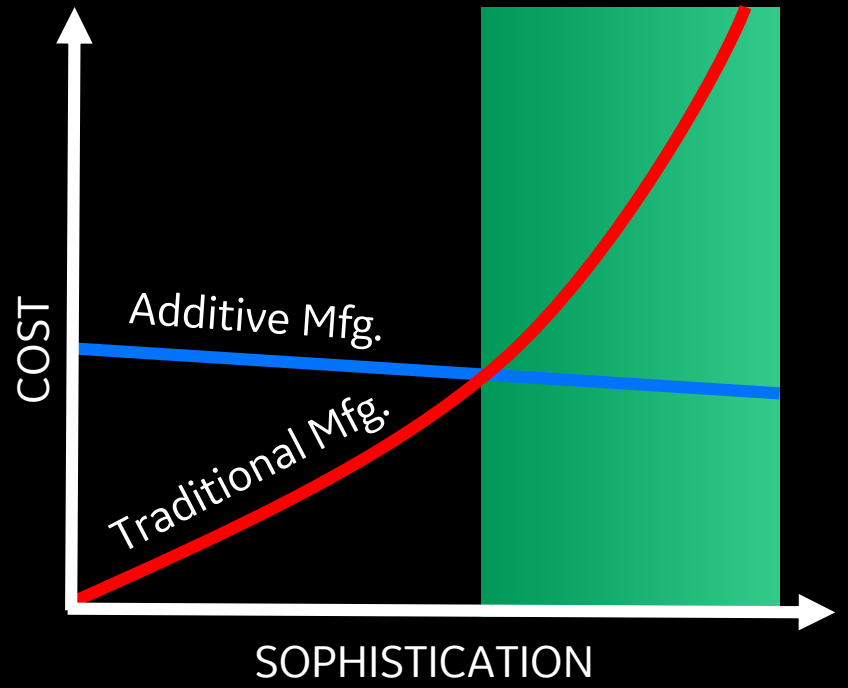
with
ADDITIVE MANUFACTURING



manufacturing cost
DECREASES



design
sophistication
INCREASES

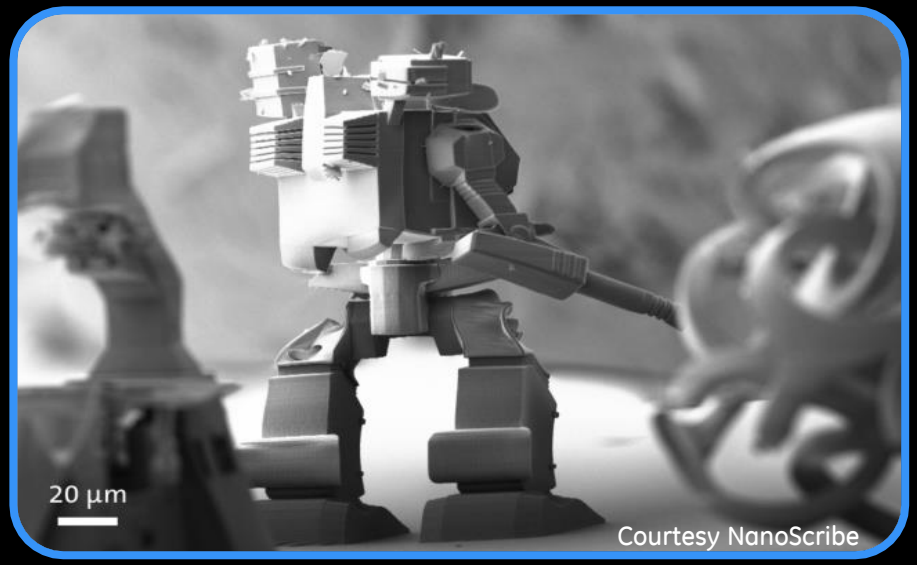


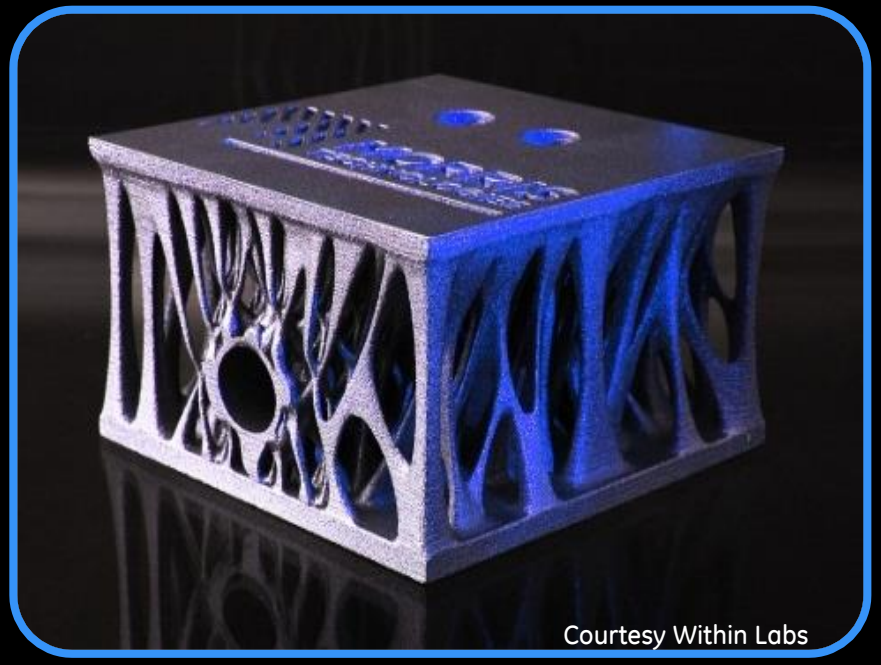
Typical Types of Additive

Polymers – SLA, SLS, FDM, PolyJet, DLP, etc…

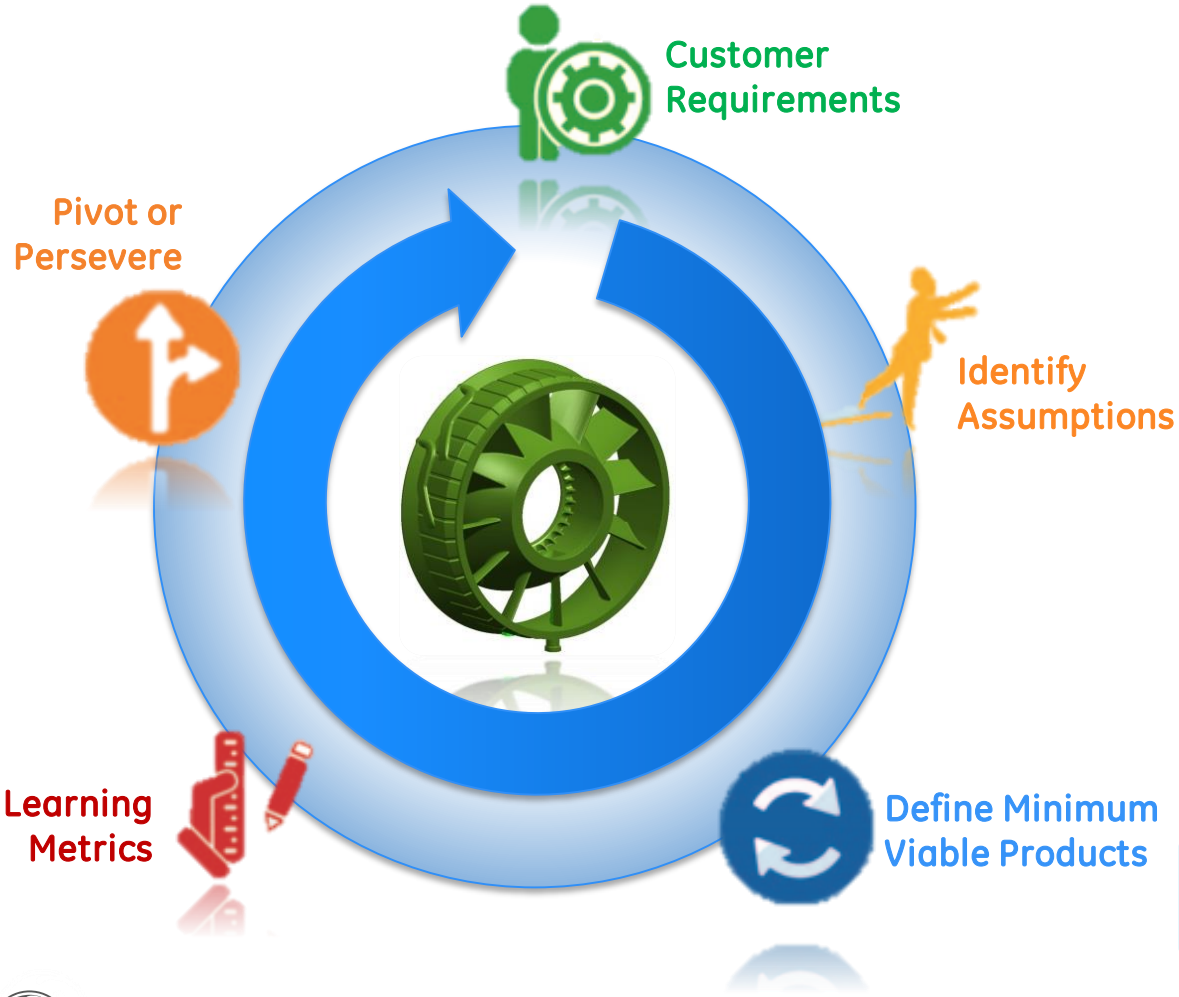
Metals – Powder Bed, Deposition, Consolidation

Emerging Micro/Nano-Additive





FastWorks – Build, Measure, Learn Strategy

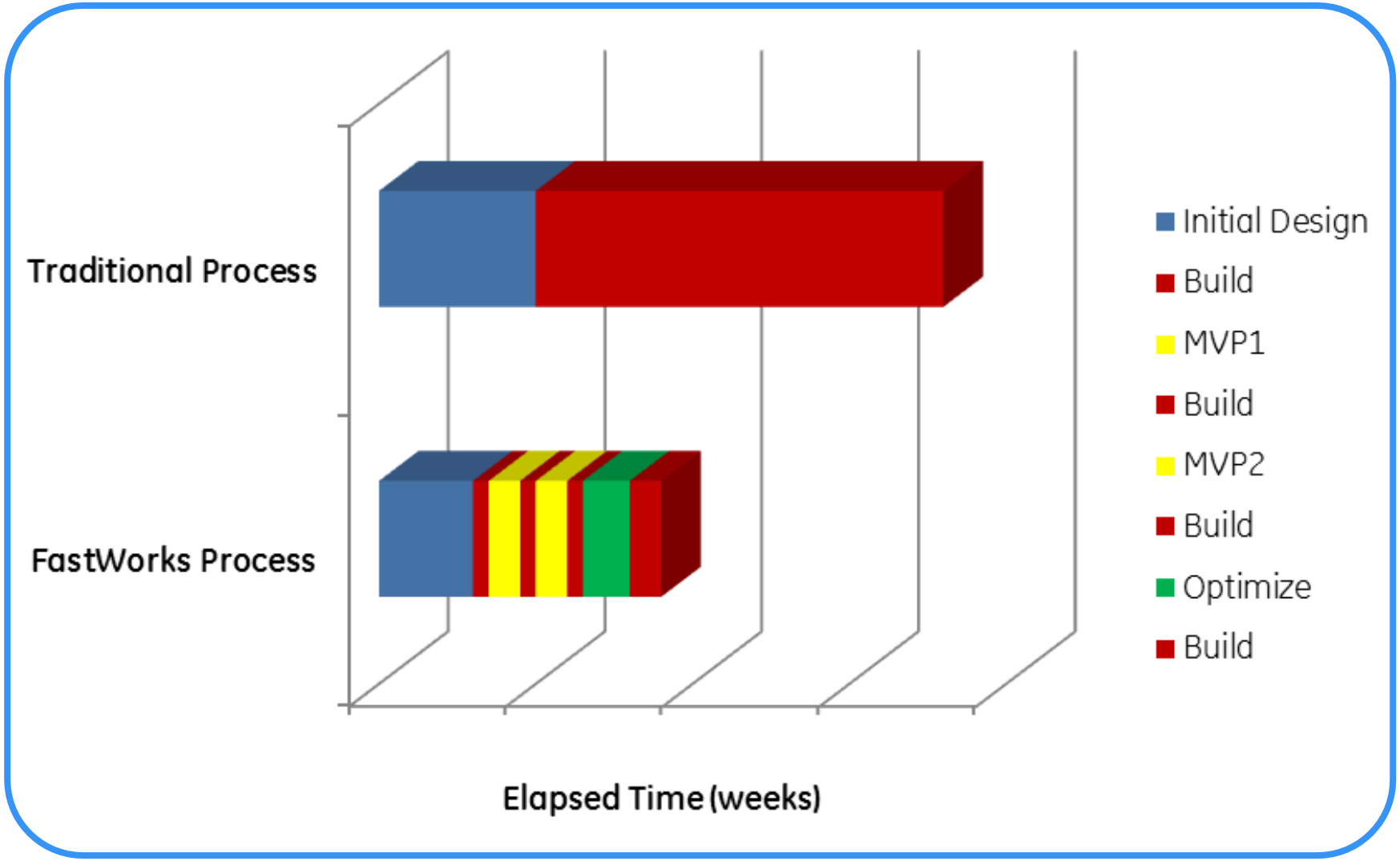


- ✓ Improves the customer experience & outcome
- ✓ Iterative approach – allows early customer engagement
- ✓ Increases empowerment & accountability
- ✓ Reduces time to implement new processes & technologies
- ✓ Increases speed to market
- ✓ Decreases risks

Additive is a Key Enabler for Speed

FastWorks … an additive advantage

Not Possible Without Additive

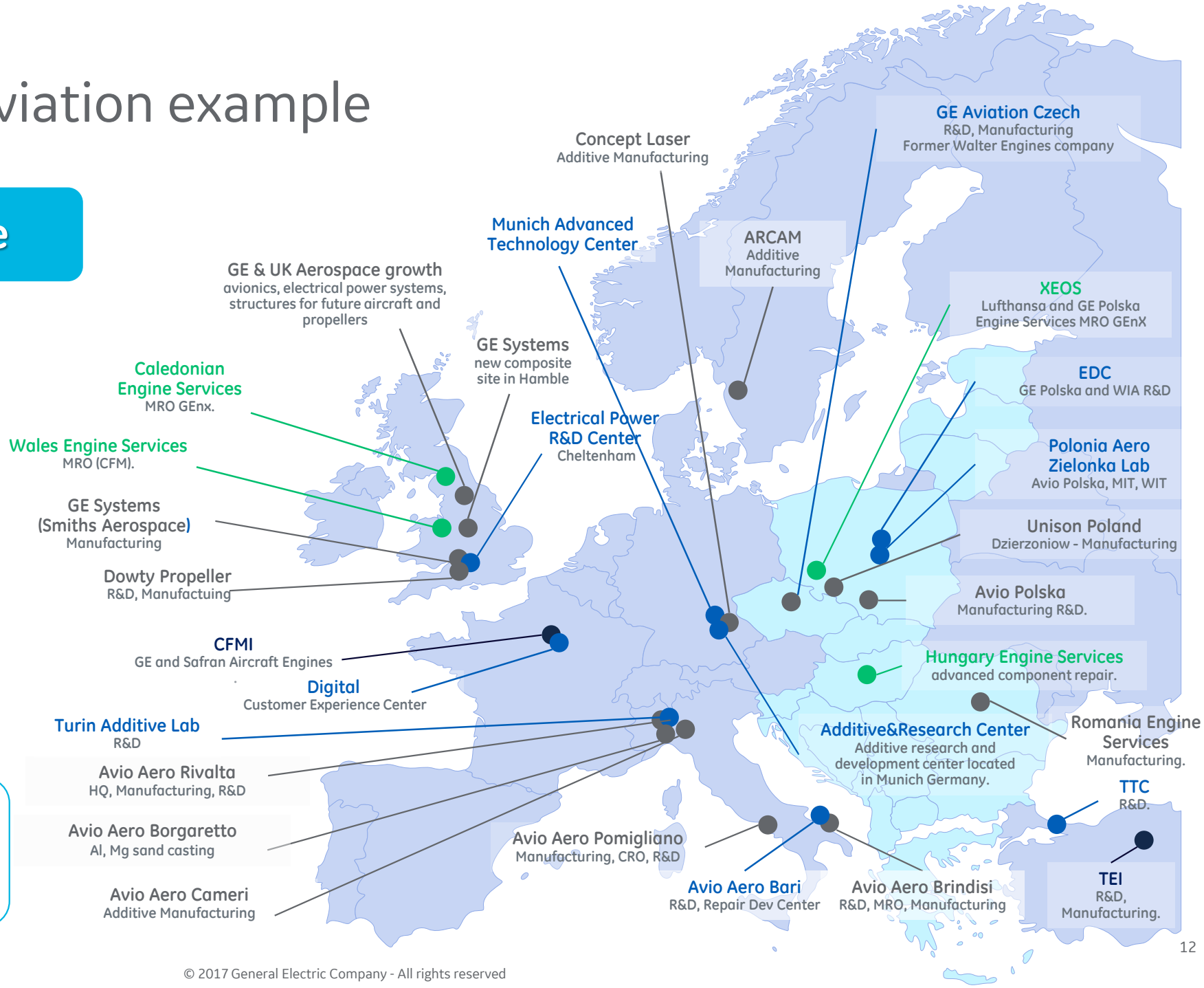


Ecosystems – GE Aviation example

Ecosystem advantage

- Geographical proximty
- Easy communication
- Close cooperation

- Shorter development time
- Continues product innovation
- Improved quality
- Reduced costs

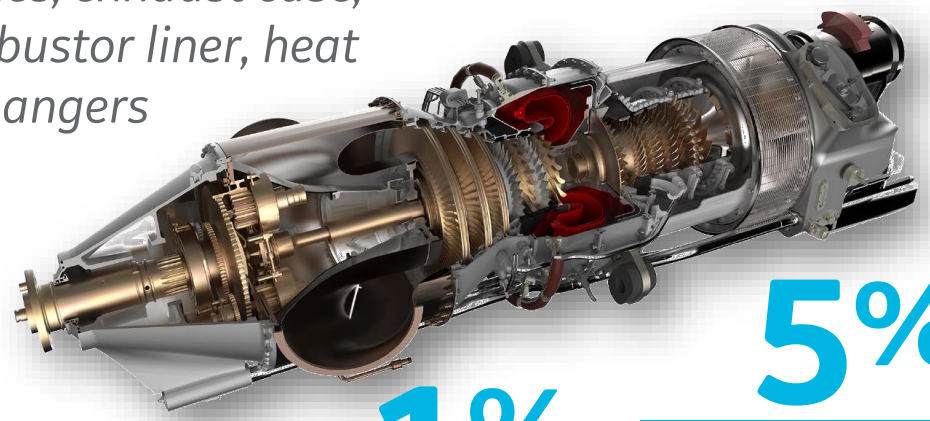


Engine Simplification: Advanced Turbo Prop

55% of major structures additively manufactured

Sumps, bearing housings, frames, exhaust case, combustor liner, heat exchangers

855 › 12
PARTS



1%
FUEL BURN REDUCTION

5%
ENGINE WEIGHT REDUCTION

ATP engine for new Cessna aircraft - Denali

25%
PART WEIGHT REDUCTION

50 › 1
PARTS

C-Sump

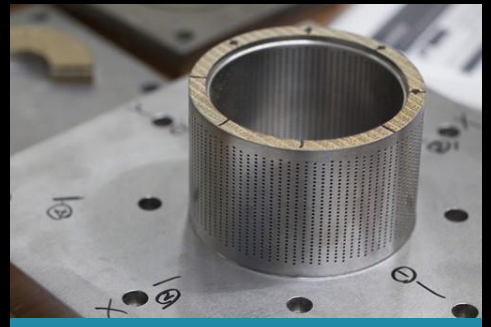
Each major component eliminates many sub-parts

A new era of design and manufacturing

POWER

AVIATION

TRANSPORTATION



OIL & GAS

HEALTHCARE