



Accelerating to the Additive Revolution

Greg Morris
Strategy/Growth Leader, GE Additive

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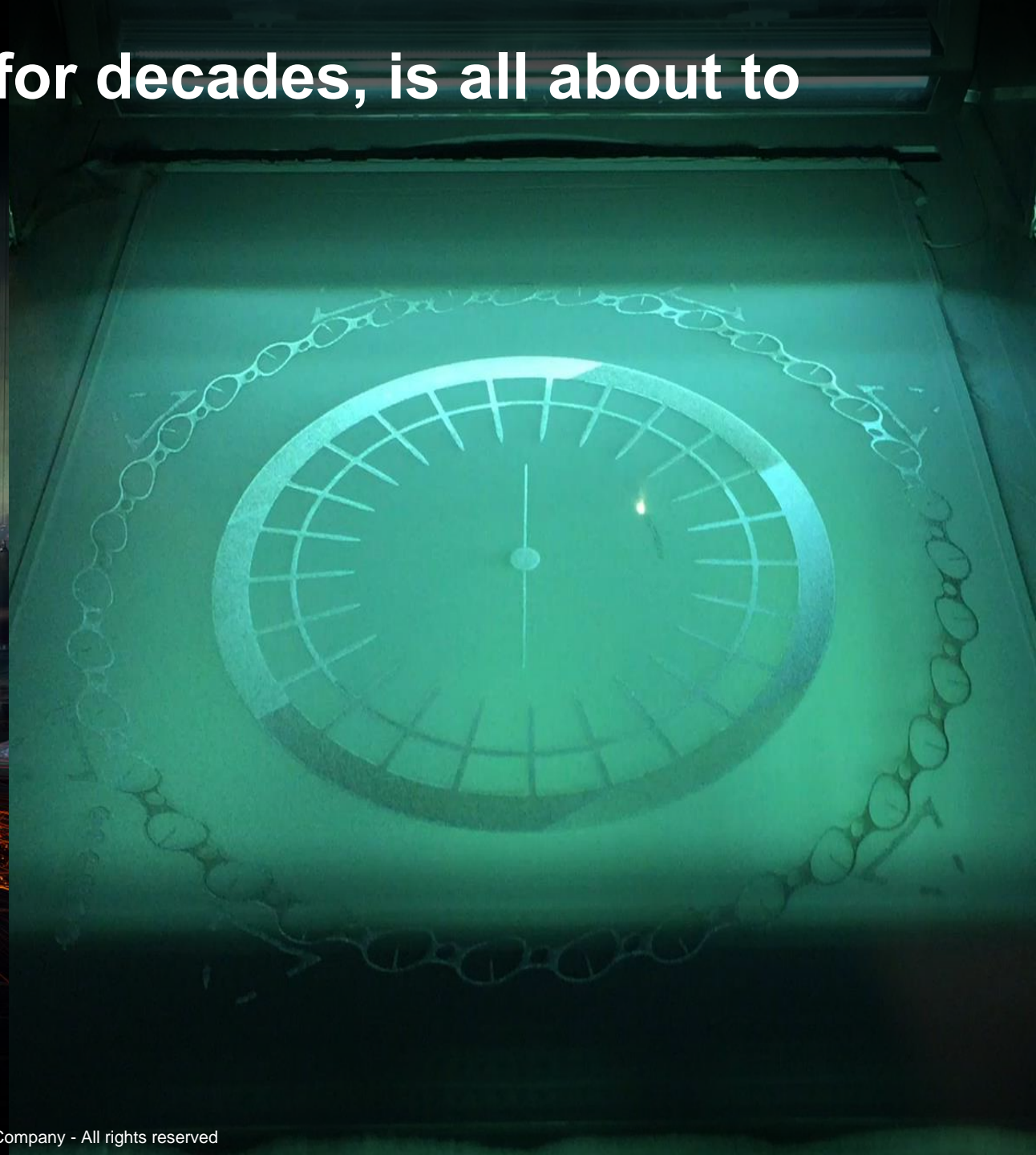
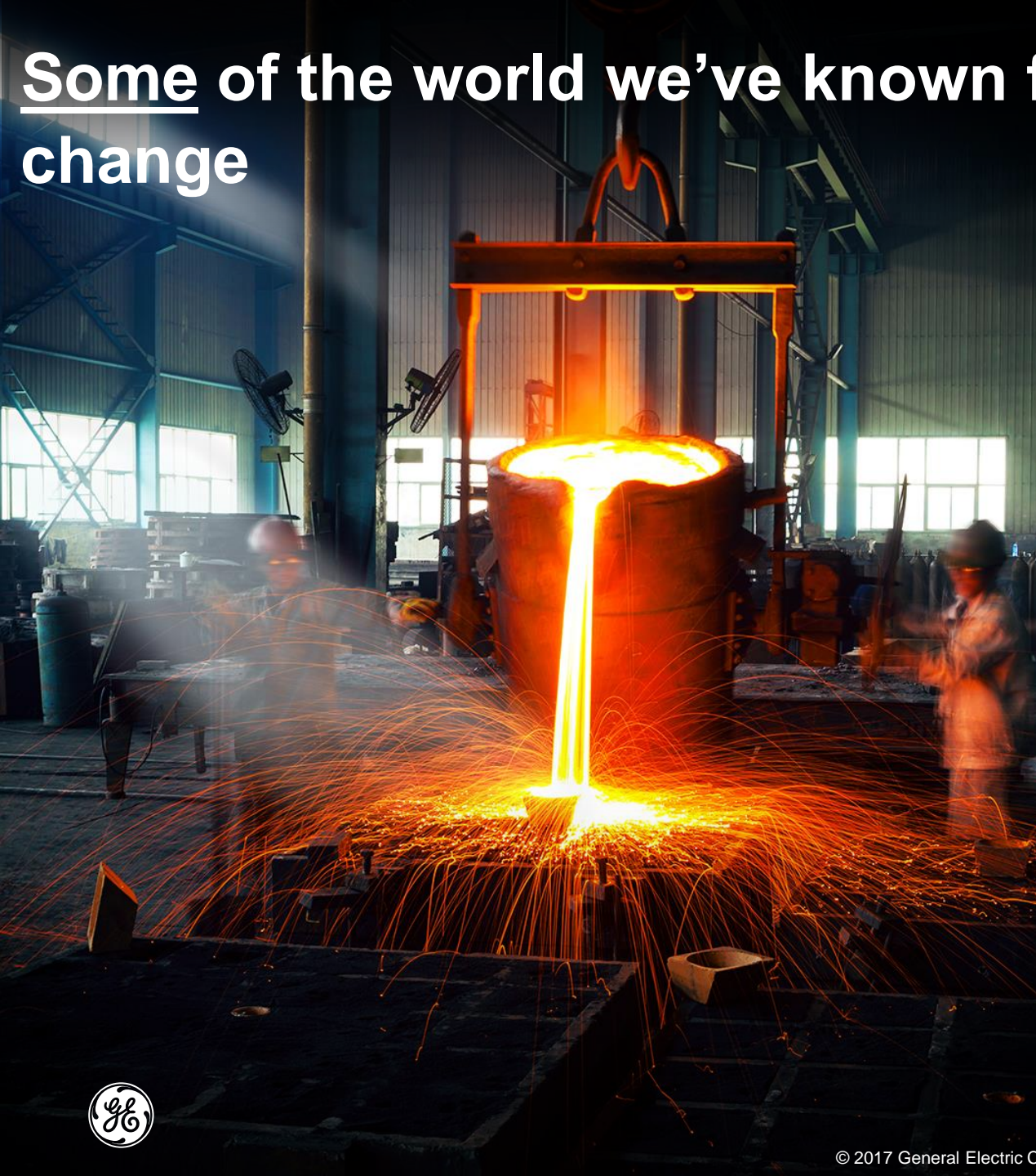
What is Additive Manufacturing?

• 3D PRINTING

- Additive manufacturing, also known as 3D printing, is a process that creates a physical object from a digital design file.
- Additive manufacturing enables engineers to design parts, systems and shapes once thought impossible to make.
- Additive manufacturing allows for complex design geometries, making products that are lighter, stronger and more efficient, revolutionizing products in many industries.



Some of the world we've known for decades, is all about to change

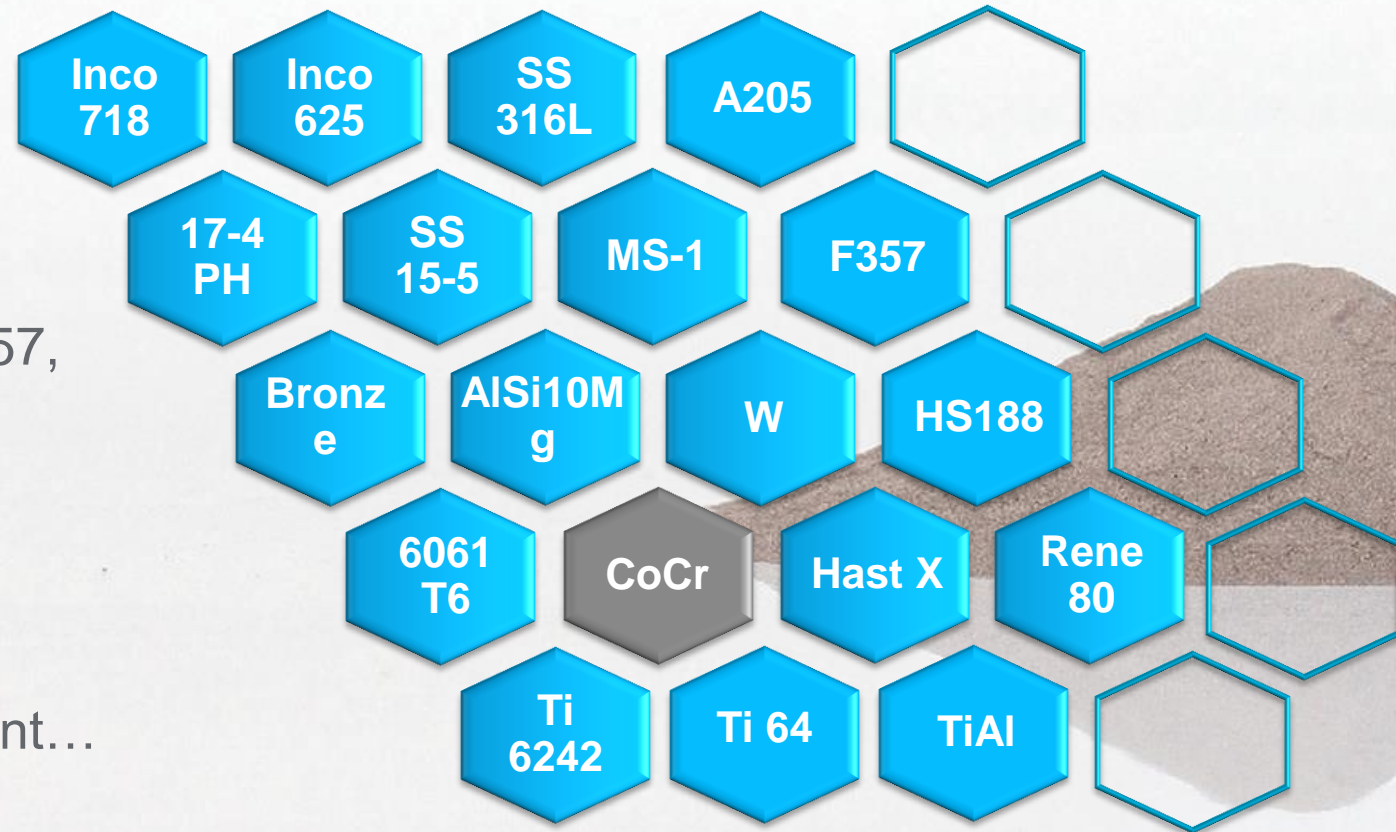


Materials



Standard Alloys Available:

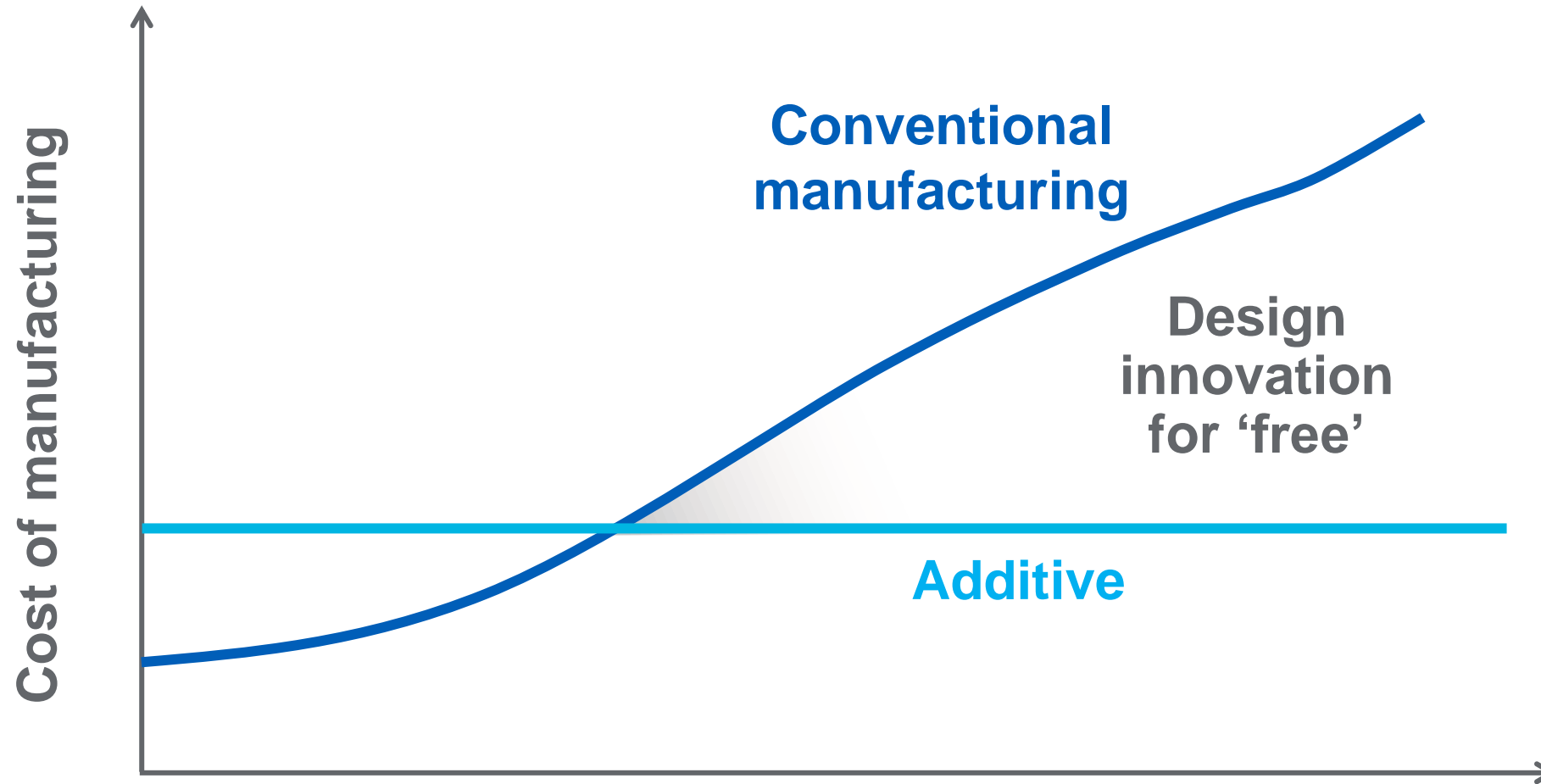
- Cobalt Chromium
- Inconel 718, 625
- Hastelloy X, HS188
- Titanium 6AlV4 & ELI, 6242, TiAl
- Aluminium (AlSi10Mg, 239A, F357, A205)
- Stainless 316L, 17-4, 15-5
- Maraging Steel MS-1



Many more materials in development...



Design Complexity with Additive Manufacturing



Degree of complexity

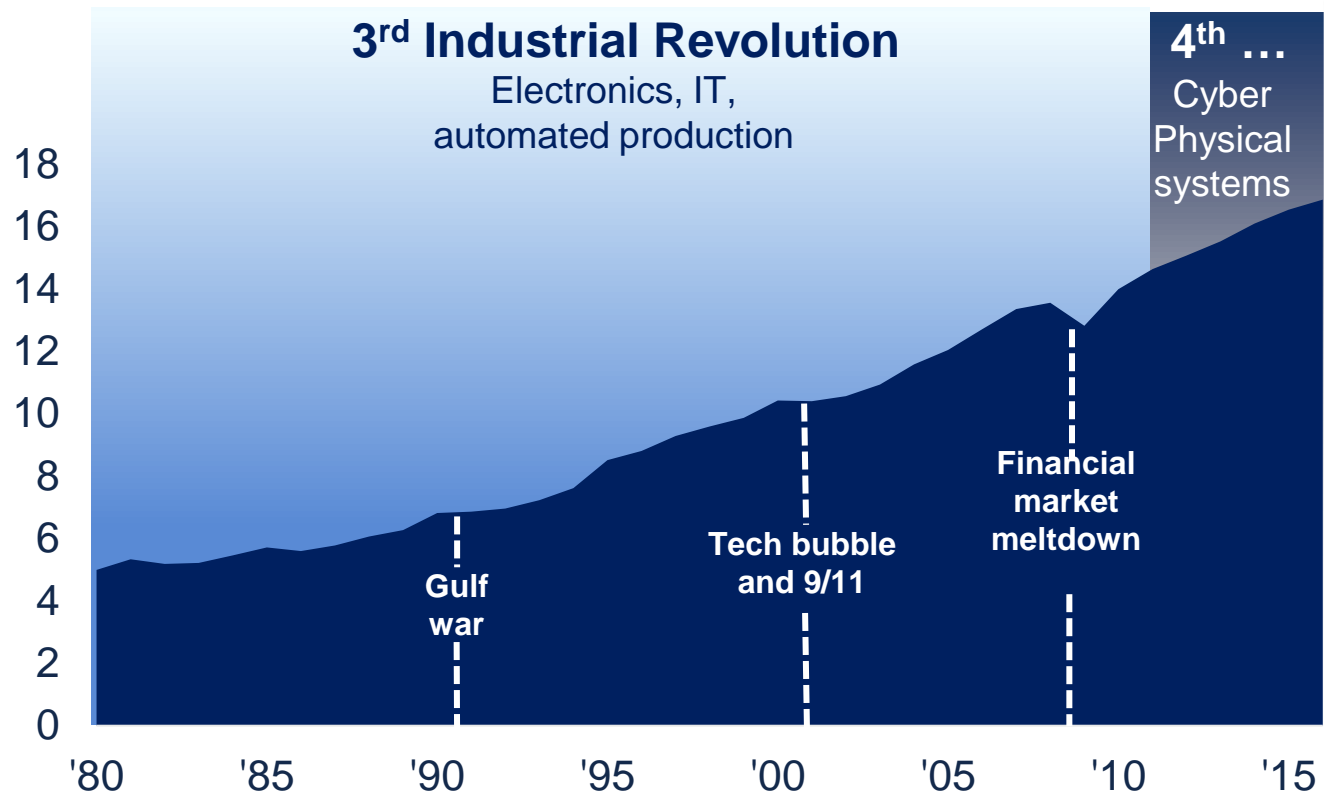
Source:



Global manufacturing grew ~ 3.2% CAGR over 35 years ... has reached \$16.9T in 2016 ... with propensity to adopt novel technology

Global Industrial Production (ex. Construction)

Value added output (\$T)



Source : Oxford economics data based on inputs from 69 countries only

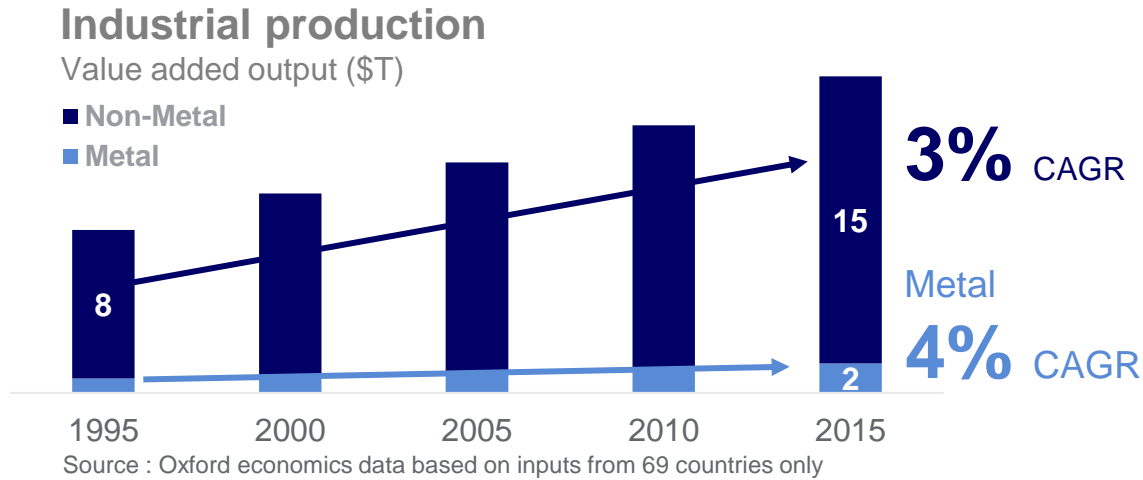
Interested and investing

Source: Forbes 2016 survey

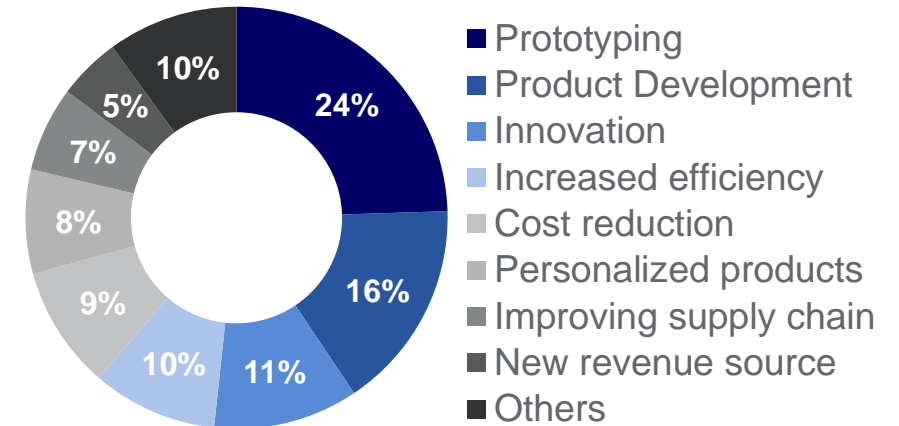
- Advanced material science **98%**
- Material bonding technologies **98%**
- Additive manufacturing **94%**
- Robotics **89%**
- Artificial intelligence **87%**



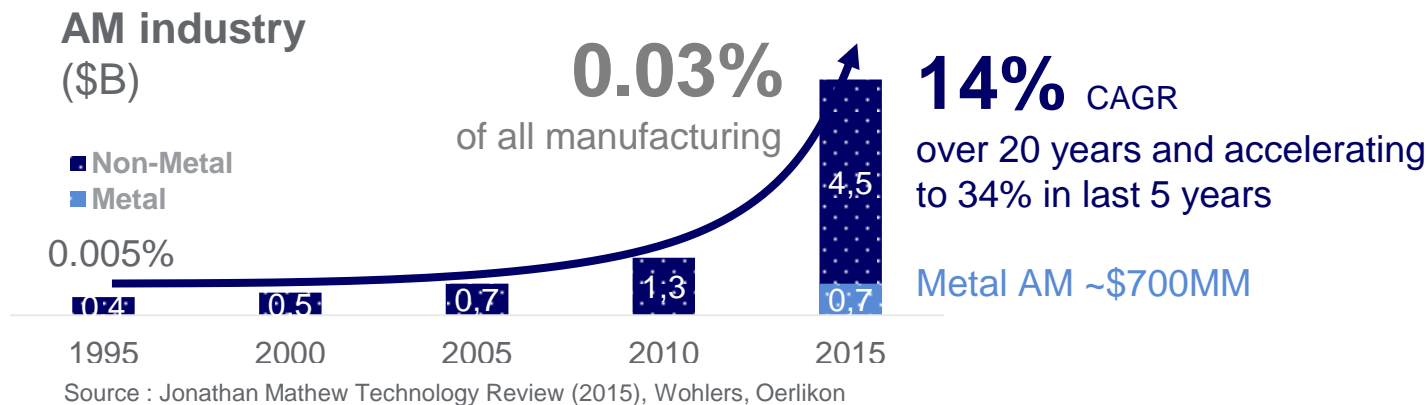
Additive manufacturing still in its infancy representing **0.03%** of a mfg ... has grown 6X in 20 yrs ... still mostly not used for production



Reasons for Pursuing 3D Printing



Source : Gartner (2014)



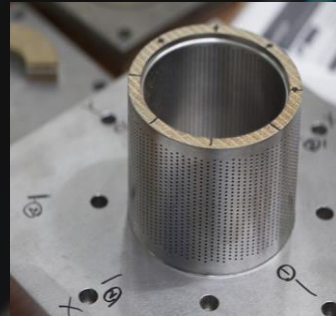
Significant opportunity – based on proof points



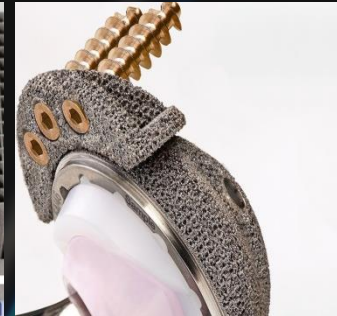
POWER



AVIATION TRANSPORTATION OIL & GAS



HEALTHCARE



MEDICAL

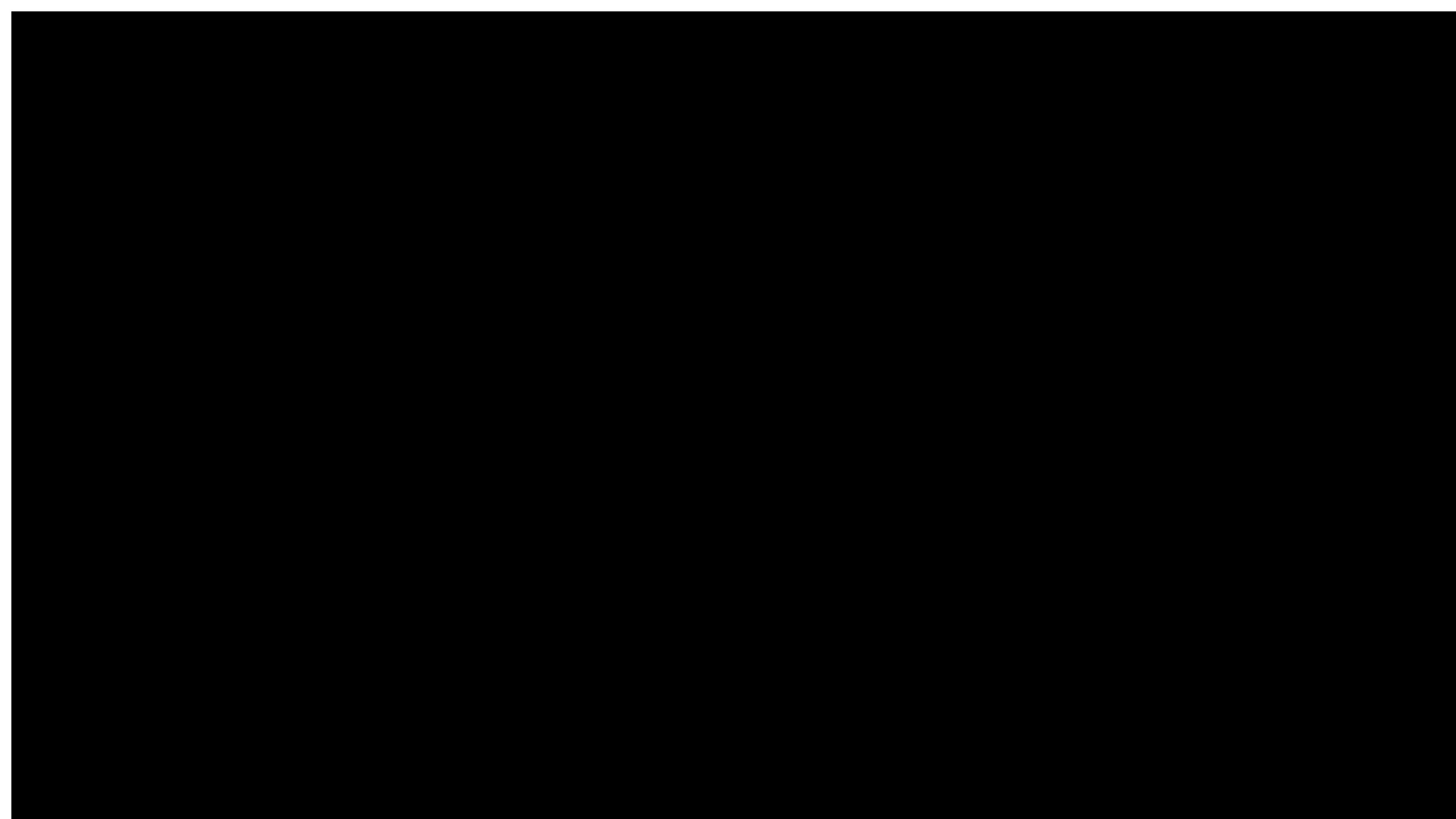


AUTOMOTIVE



GE Additive Centers





GE's additive journey ... so far

\$5B+

INTERNAL COST EFFICIENCY

Technology

Infrastructure

1st LEAP Fuel Nozzle

1st Heat Exchanger

GE90 engine T25 Sensor Certified

GE9X Low Pressure Turbine Blade

Power F-Class Flex Tip

Fuel Nozzle Certified

Oil & Gas Nova LT Swirler

A-CT7 Engine

Advanced Turboprop Engine Prelim design

2010

2011

2012

2013

2014

2015

2016

2017

Formation of GE Aviation's additive team

Acquisition of Morris Technologies

GE Aviation Additive Technology Center (ATC) opens

Center for Additive Technology Advancement (CATA) opens

Acquisition of Arcam AB & Concept Laser

GE Additive launched



CONCEPTLASER
a GE Additive company



LEAP fuel

nozzle

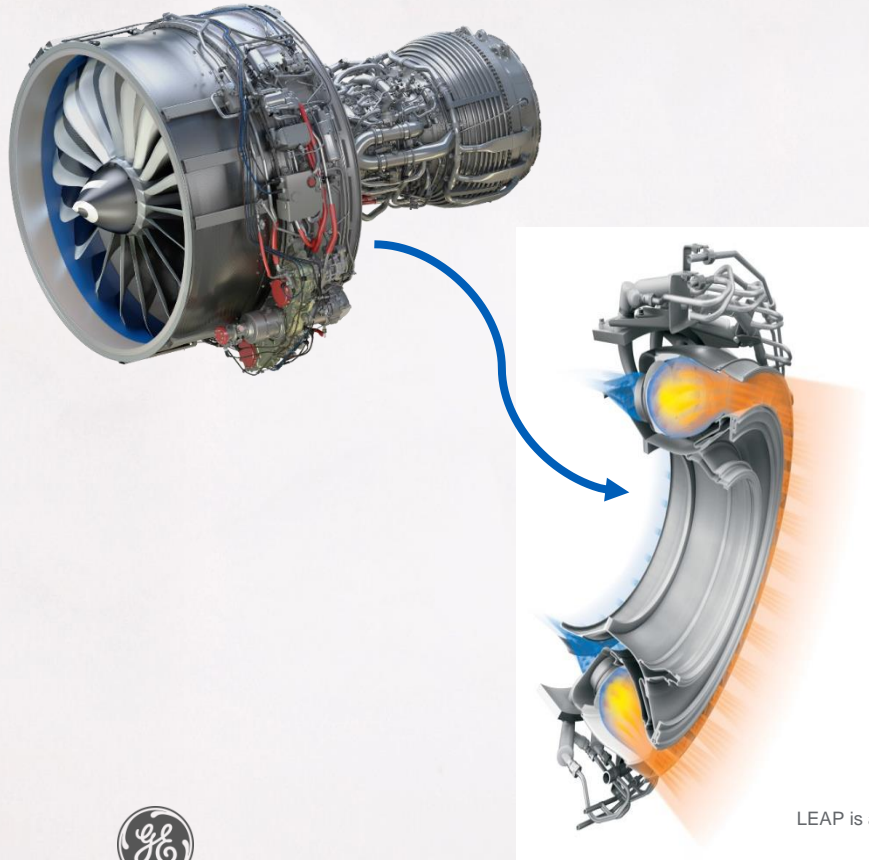
Full production:

35,000 – 40,000 per year

20:1
PARTS

25%
WEIGHT
REDUCTION

5x MORE
DURABLE



LEAP is a trademark of CFM International, a 50/50 JV between GE and Safran Aircraft Engines

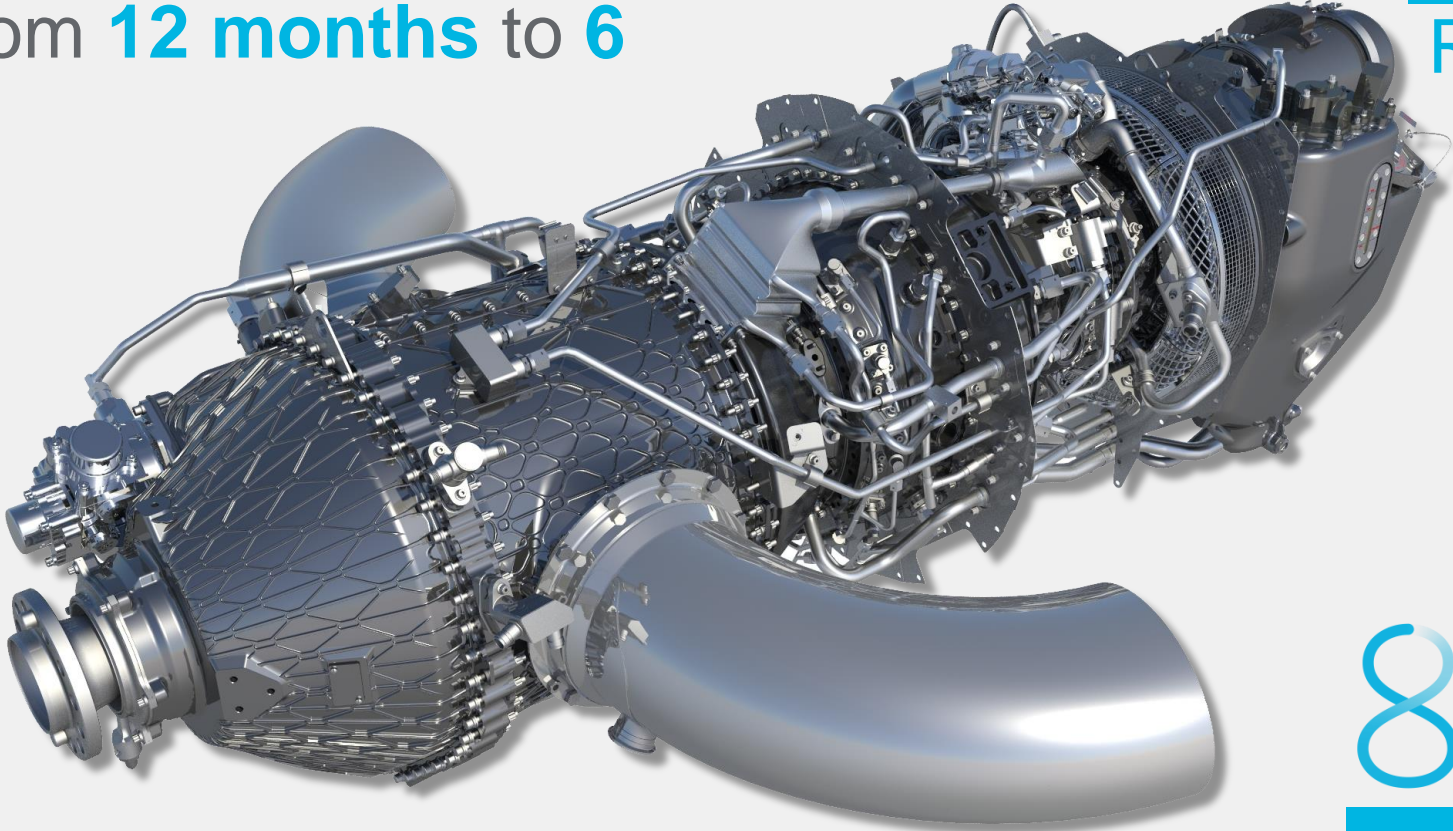
Advanced TurboProp engine (ATP)

Combustor test schedule reduced from **12 months** to **6 months**

20%

LOWER MISSION

FUEL BURN



5%

WEIGHT REDUCTION

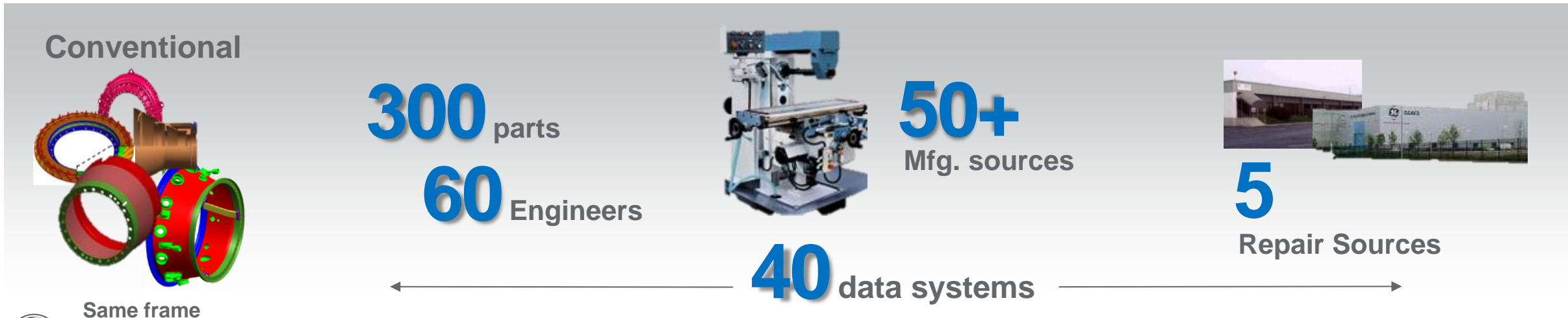
855 → 12

PARTS



At an enterprise level

Design → Manufacturing → Services



Placeholder confidentiality disclosure. Edit or delete from master slide if not needed.

Indirect use of Additive



Equiax



Directional solidified



Single Crystal

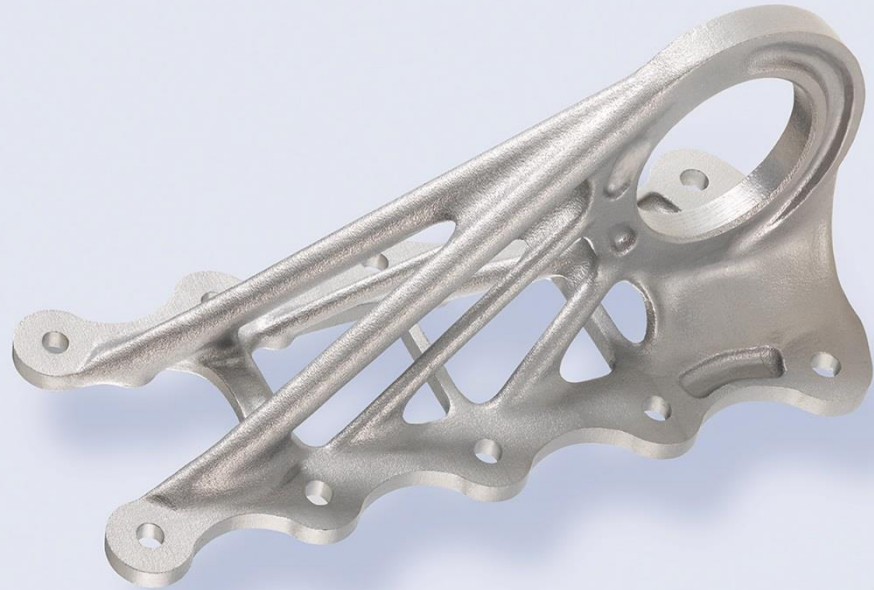


Ceramic Matrix Composite

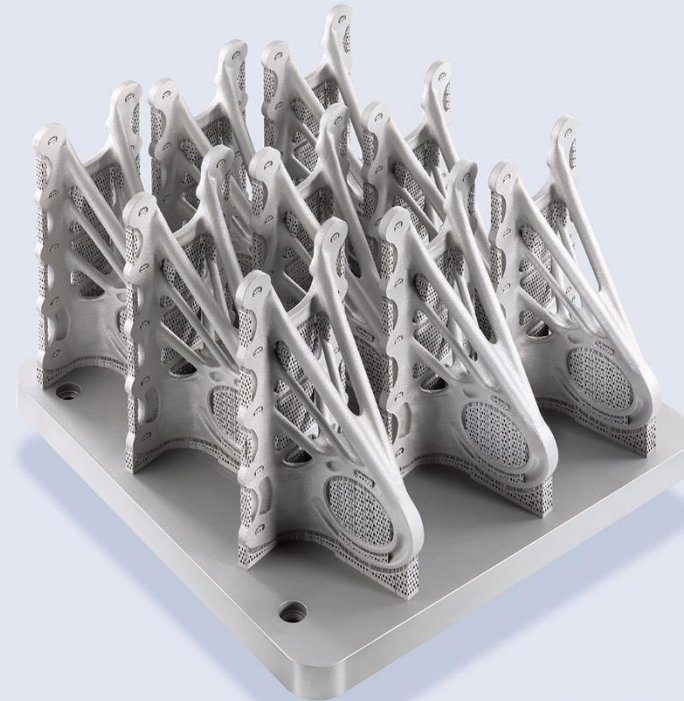
Direct Core Enables



Aerospace Bracket



LaserCUSING®
Source: Airbus Operations GmbH



LaserCUSING®
Source: Airbus Operations GmbH

Investments in Additive - \$1.5 Billion +

CONCEPTLASER
a GE Additive company

Mlab



Mline



M2

Xline



ArcamEBM
a GE Additive company



Q10



Q20



A2X

World class Material Capabilities

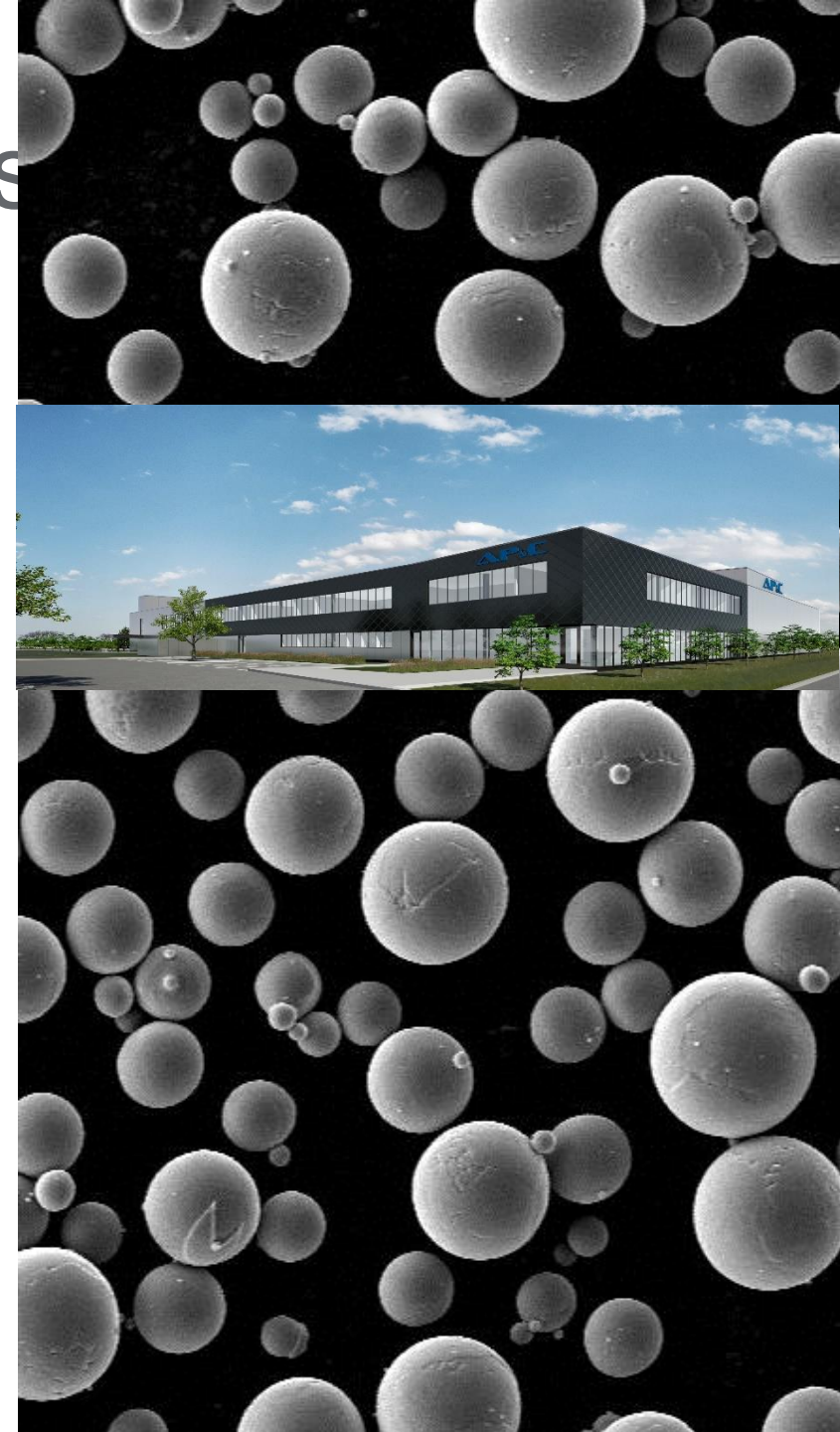


Global leader in AM metal powder manufacturing

Deep Knowledge and Expertise in AM powder properties and design

New state of the art manufacturing facility to open in 2017

Investing in the future and innovation to expand material offering



Today: \$7 Billion Industry

2030: ~\$100 Billion
Industry?



