The Future of Industrial Manufacturing is Already Here

Success with 3D Printing on the Factory Floor

Rob Keogh – Markforged

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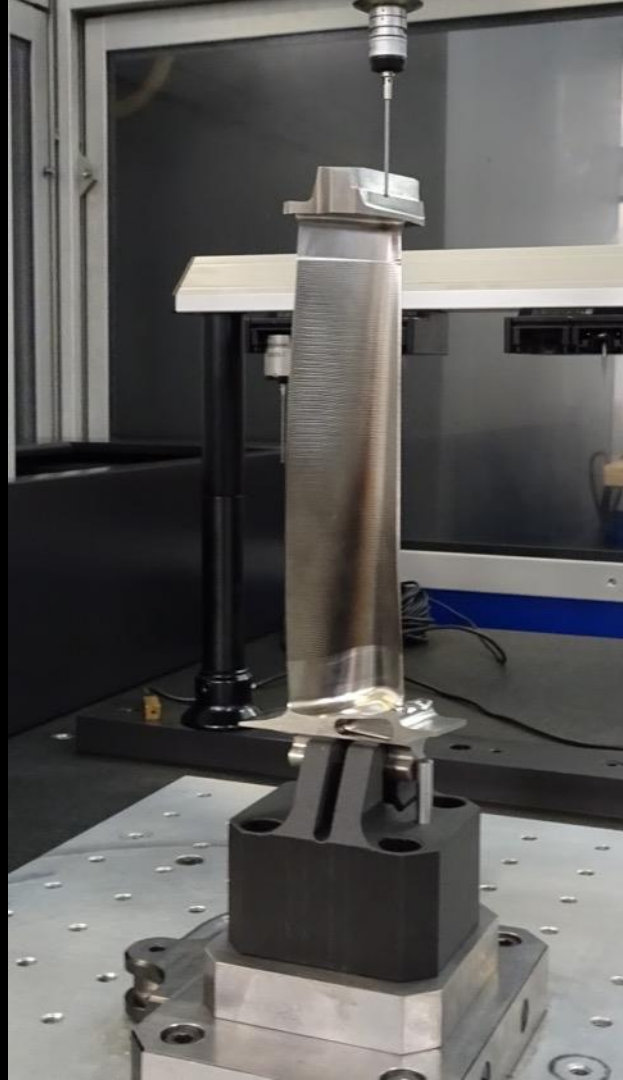

Agenda

About Markforged

The Next Evolution of Manufacturing

MetalX

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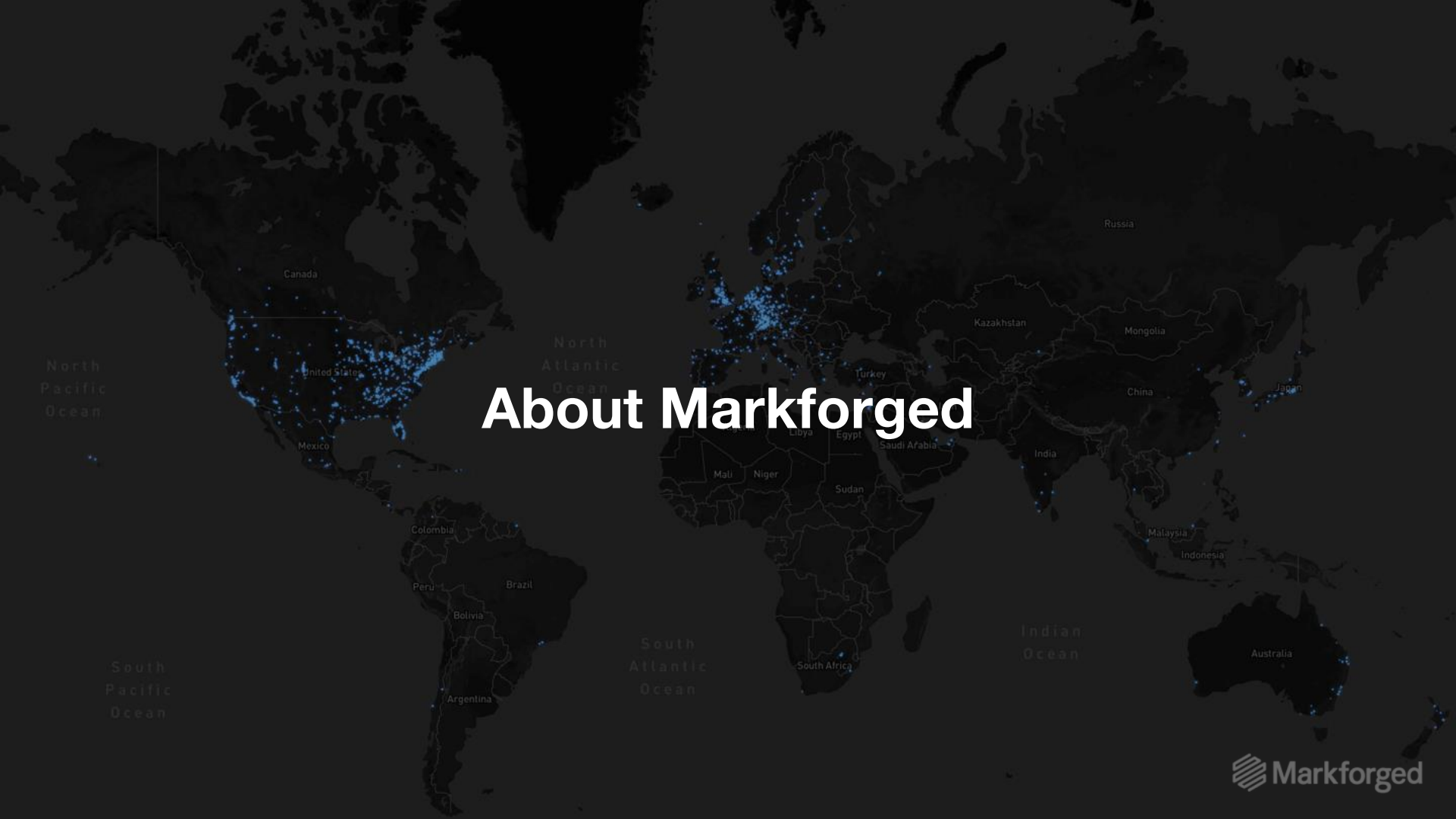

About Markforged

Markforged

Markforged enables customers to produce stronger, functional parts faster and at lower cost, that serve the needs of a wide range of applications across the entire manufacturing lifecycle.

Extrusion-based 3D Printing

Fused filament fabrication (FFF)

Feedstock is melted plastic filament

Prints made one layer at a time

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Continuous Filament Fabrication (CFF)

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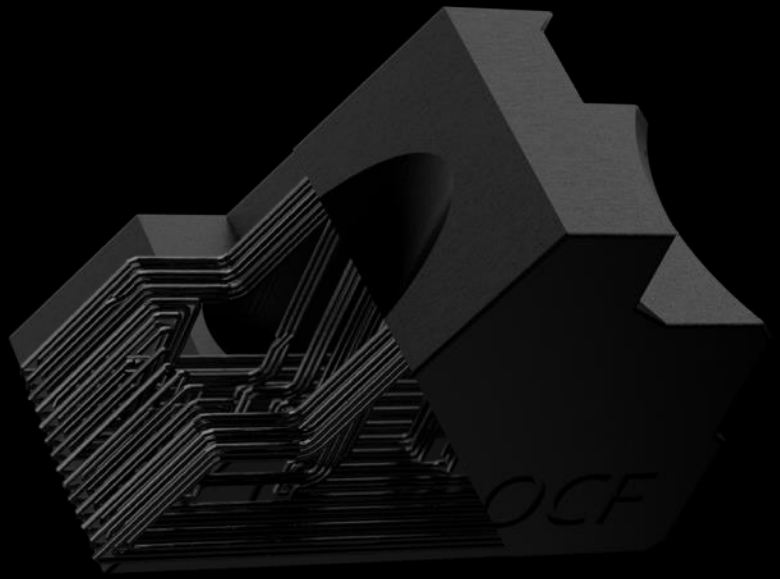
MATERIALS

Composites Materials



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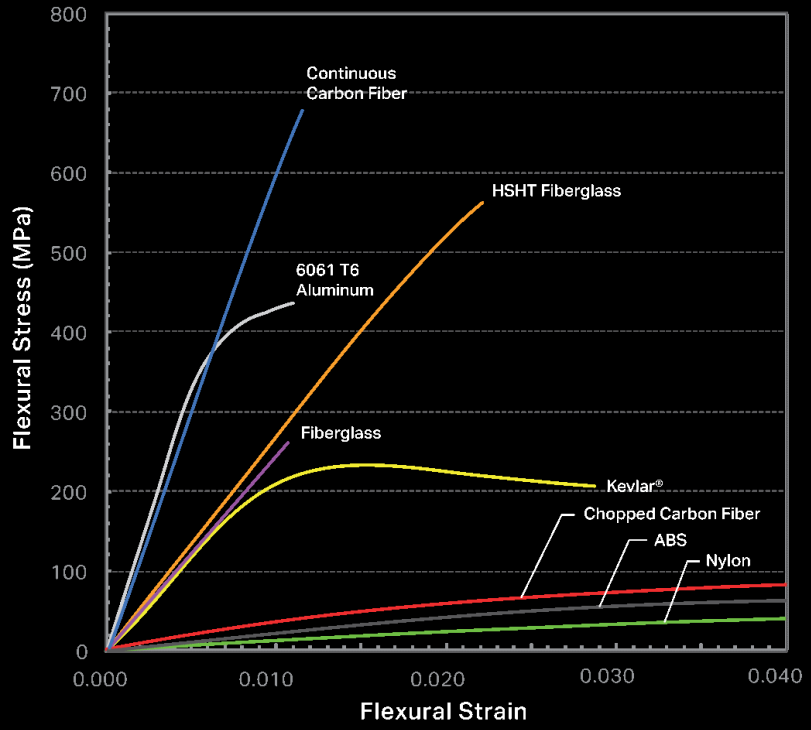
MATERIALS

Composites Datasheet



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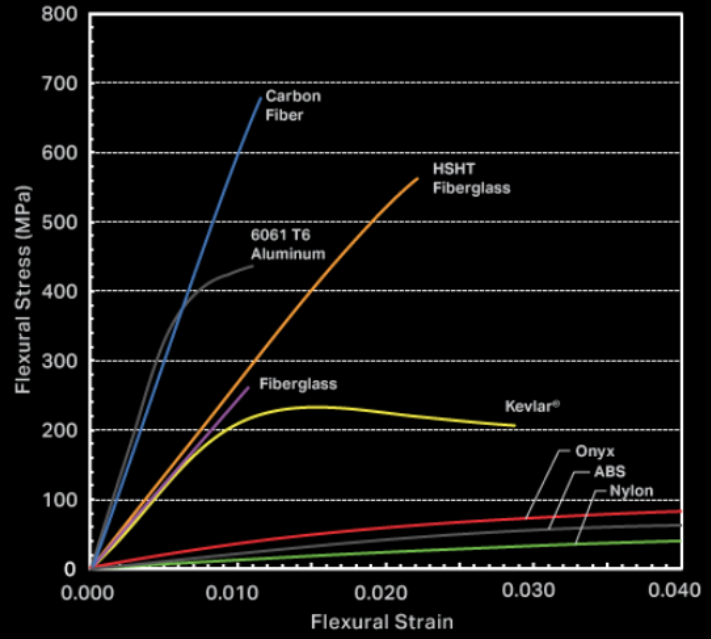
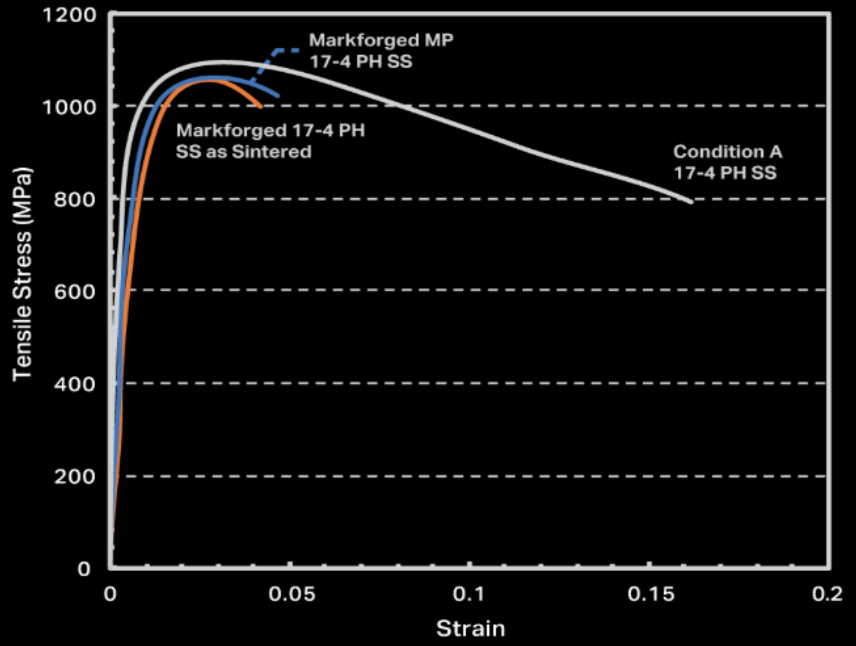
THE FULL RANGE OF

Materials

COMPOSITES

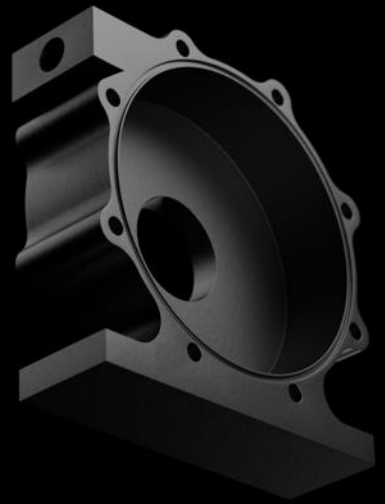


METALS



THE ENTIRE

Range of Materials



Plastics

Composites

Metals

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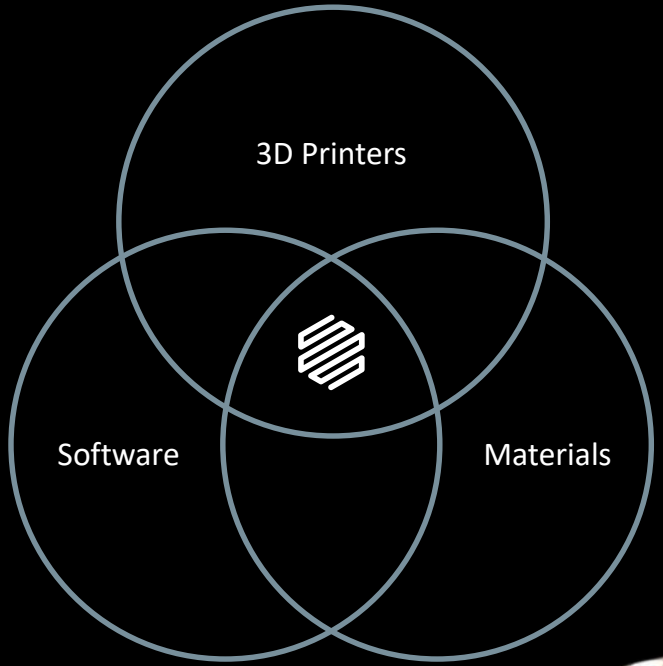
TECHNOLOGY

Industrial 3D Printing Platform



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The Next Evolution of Manufacturing

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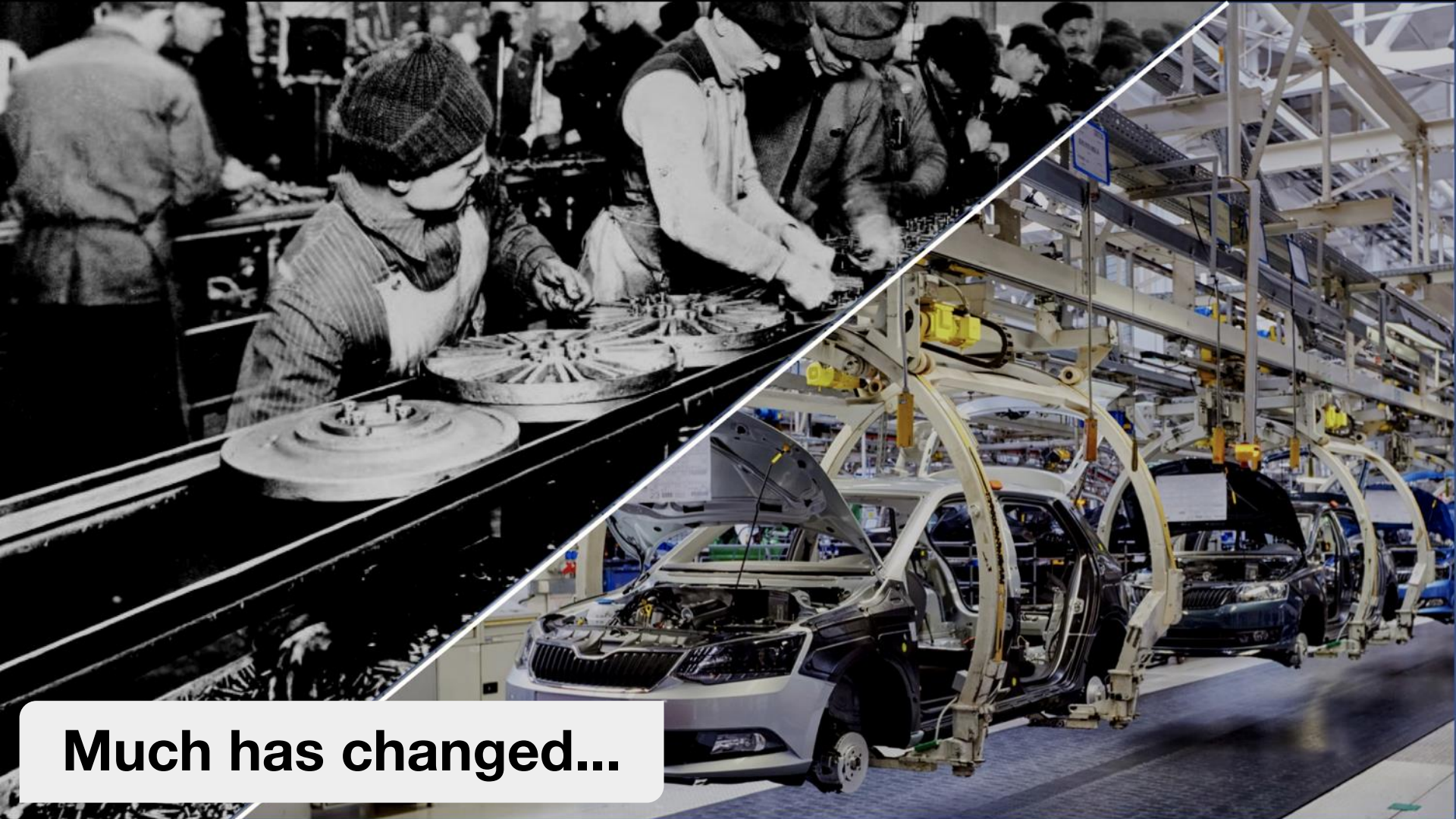
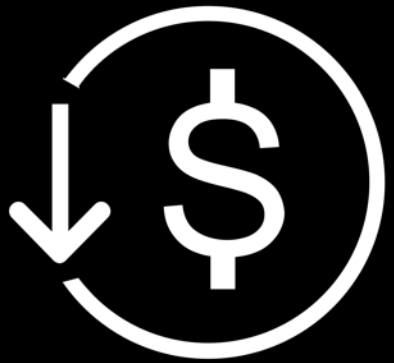


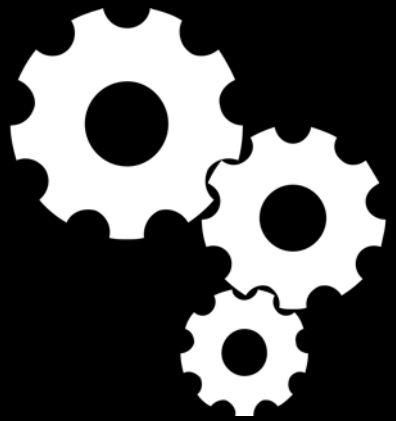
Much has changed...


...but a lot hasn’t

Manufacturing Pressures Have Only Increased



Cost Reduction



Efficiency

Speed to Market

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1st Revolution
Water/Steam

1784

2nd Revolution
Electricity/Mass Production

1870

3rd Revolution
Electronics/Automation

1969


The steam engine raised the
standard of living for humanity


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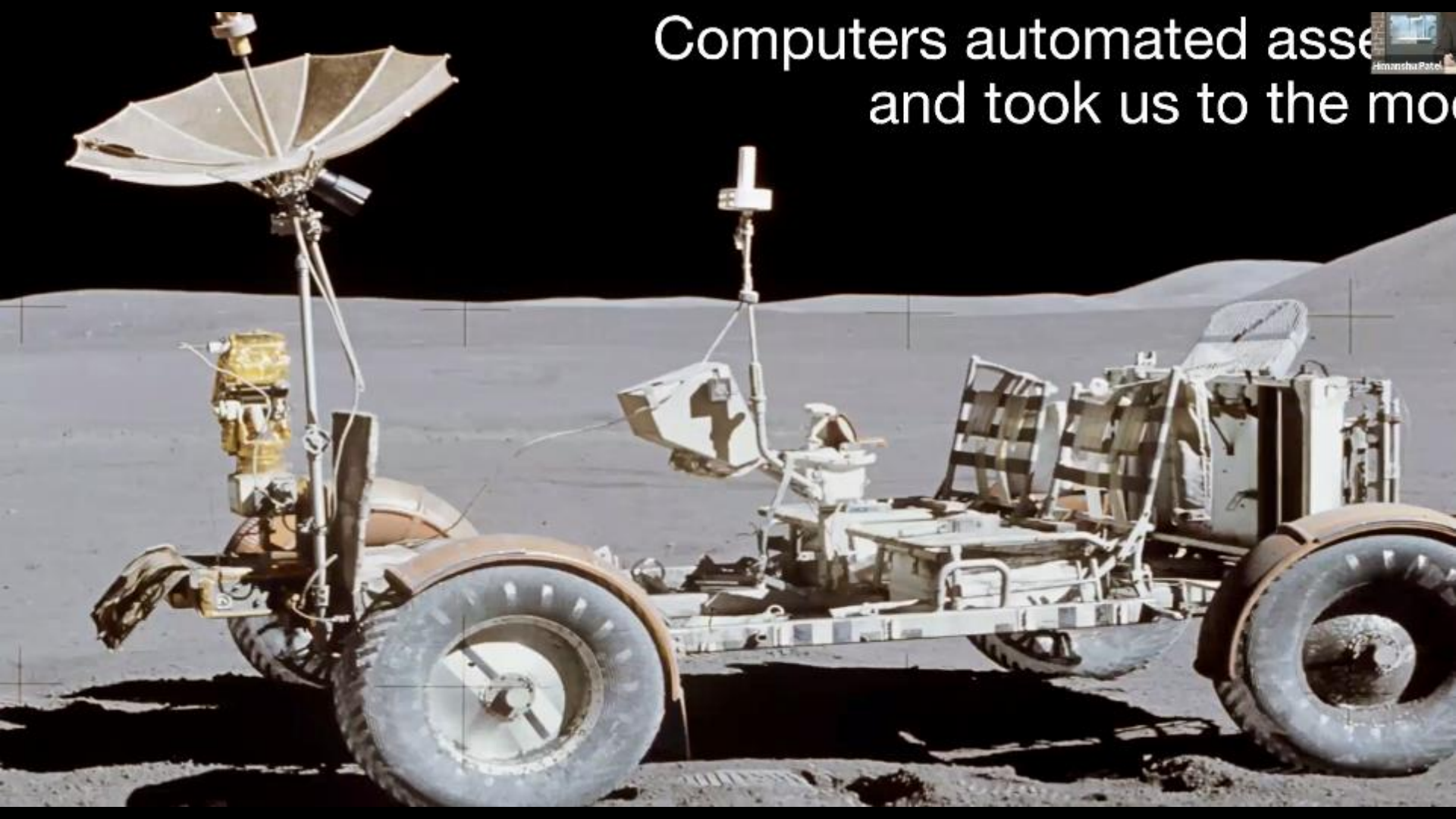
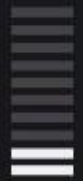

Computers automated asse
and took us to the mo

The 4th Industrial Revolution is here, digital manufacturing is changing everything

1st Revolution
Water/Steam

100%
Complete replacement with new tools

2nd Revolution
Electricity/Mass Production



20%
Tooling equipment kept, only conveyor belt required

3rd Revolution
Electronics/Automation

90%
High replacement of tooling equipment by machines

4th Revolution
Digital Manufacturing

50%
Partial replacement, Upgrade existing equipment

Statistisches Bundesamt; Deutsche Bundesbank; Prognos; Thomas Nipperdey; Mckinsey & Company

McKinsey&Company

WORLD ECONOMIC FORUM

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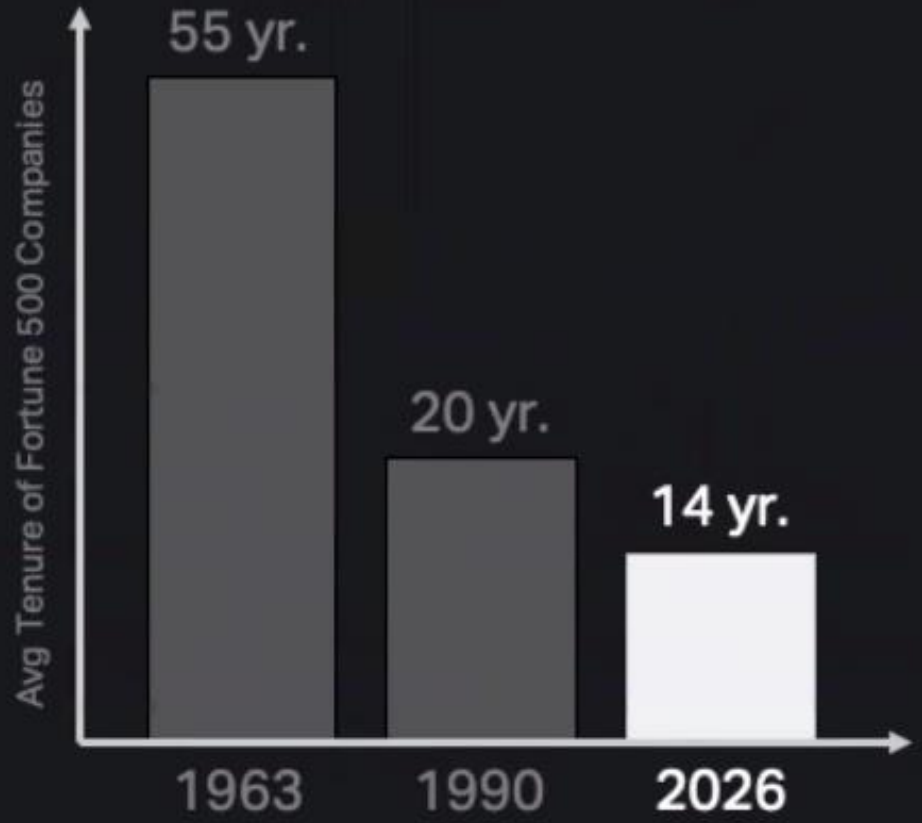
In the last 15 years, **52%** of Fortune 500 companies have disappeared




DIGITAL MANUFACTURING
Digital Factories Assembling Digital Inventory
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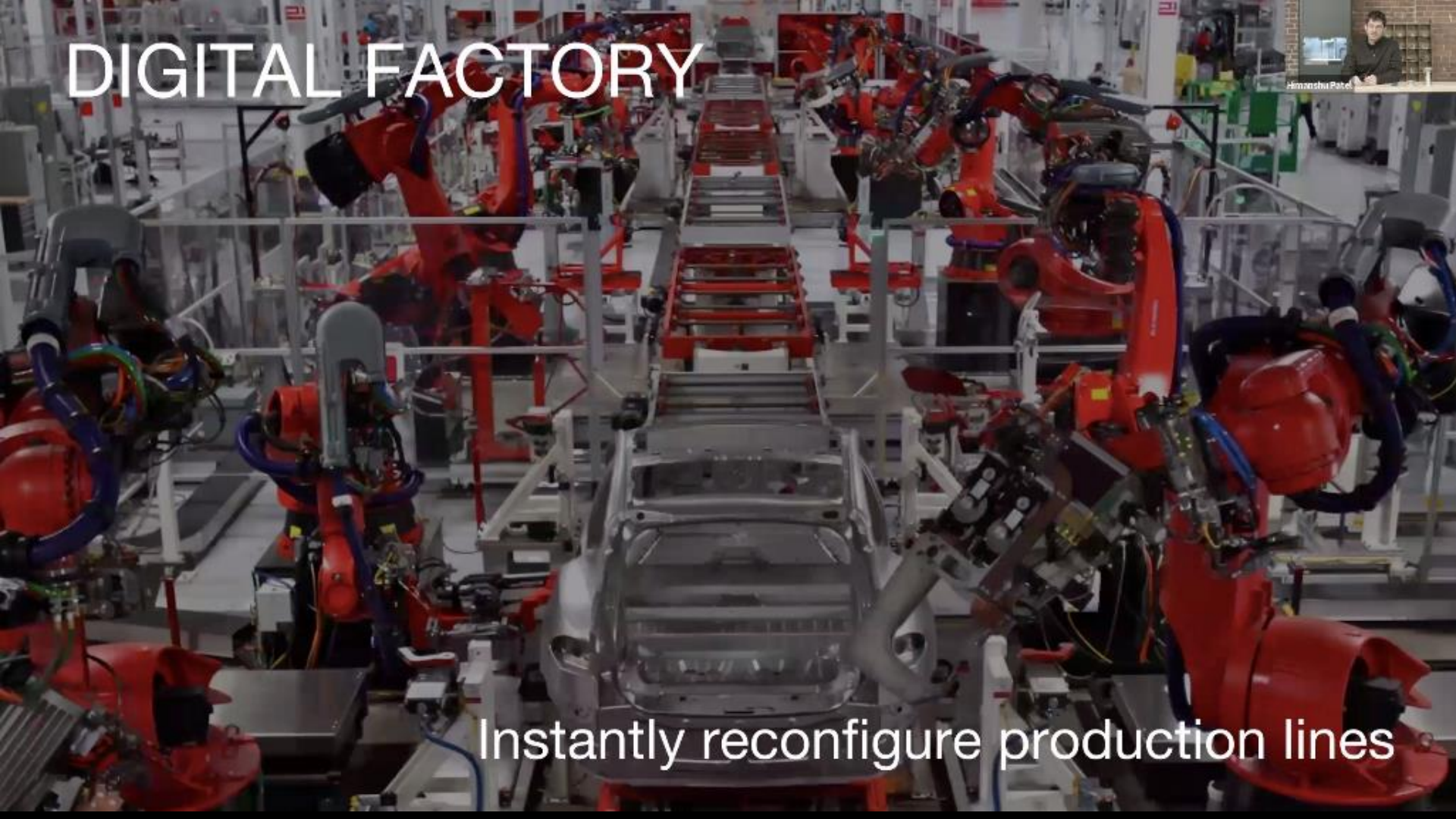
DIGITAL FACTORY



Instantly reconfigure production lines

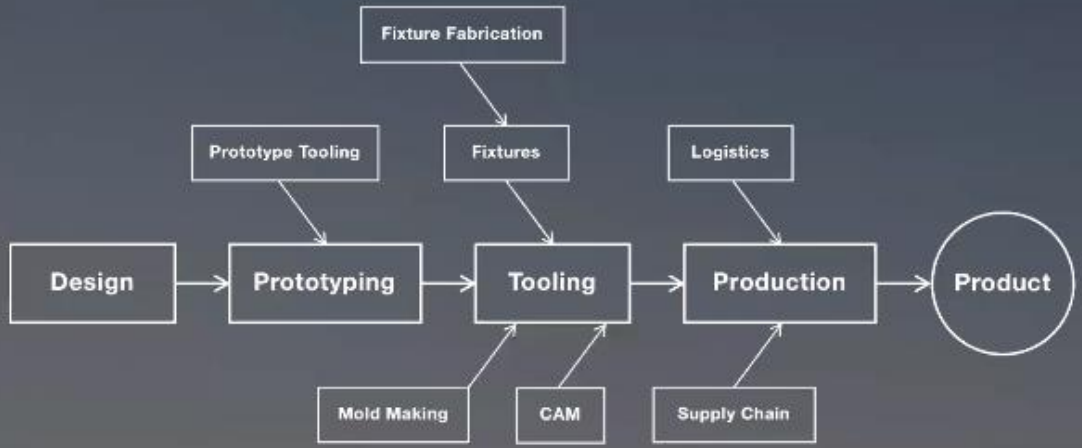
DIGITAL INVENTORY

Any material, any shape, on-demand

Here's where it ends...

Manufacturing	Offshore	→	Local
Logistics	Global	→	Last mile
New Product Dev.	Slow	→	Fast
Production Cost	High	→	Low
Demand Planning	Uncertain	→	Predictable

The way things are made has changed for good



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Atomic Diffusion Additive Manufacturing (ADAM)

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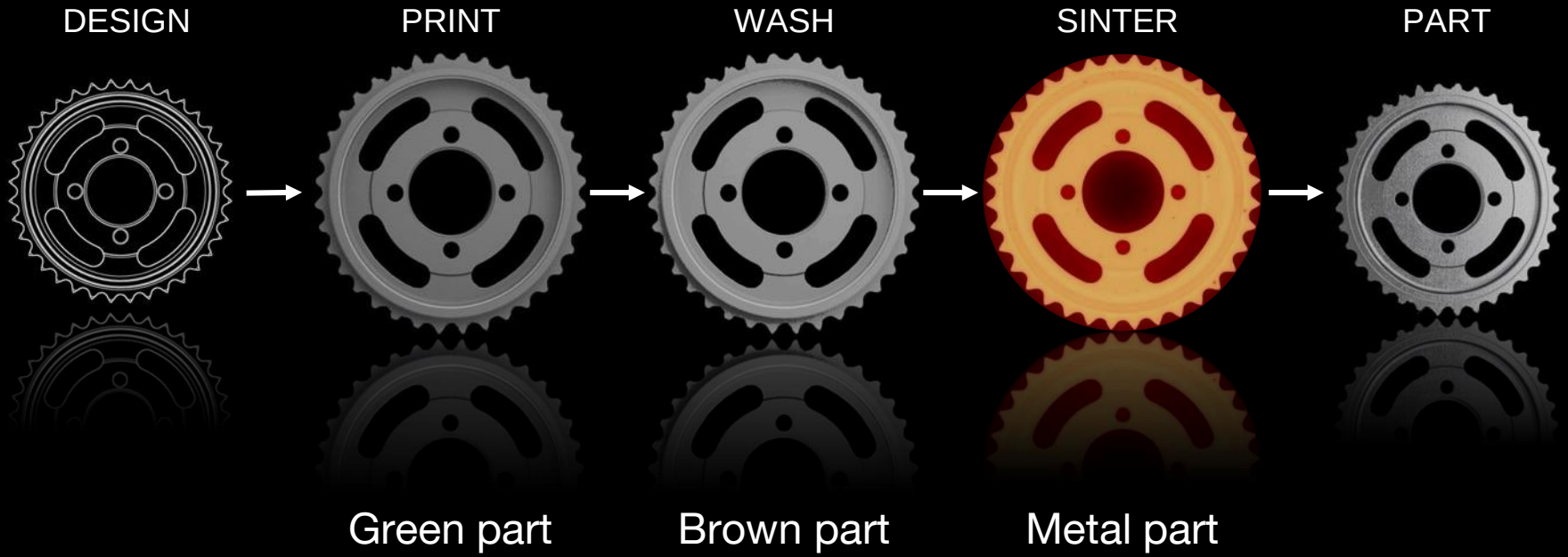
ADAM Process Overview



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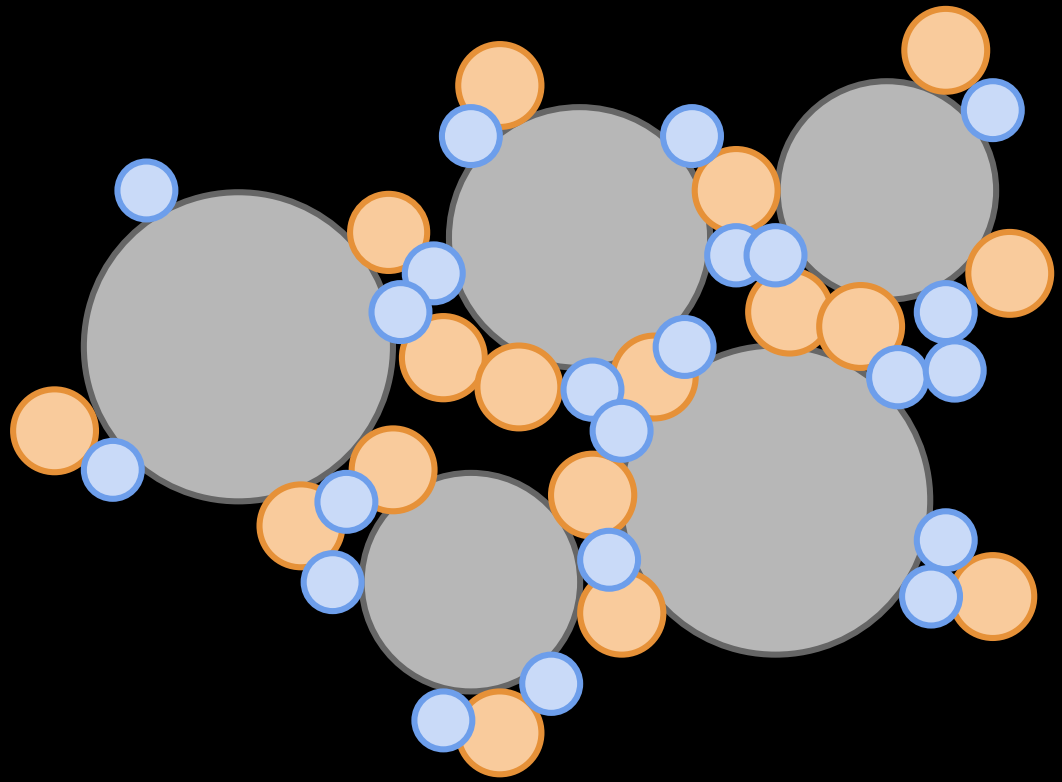
After Printing: Green ADAM Part



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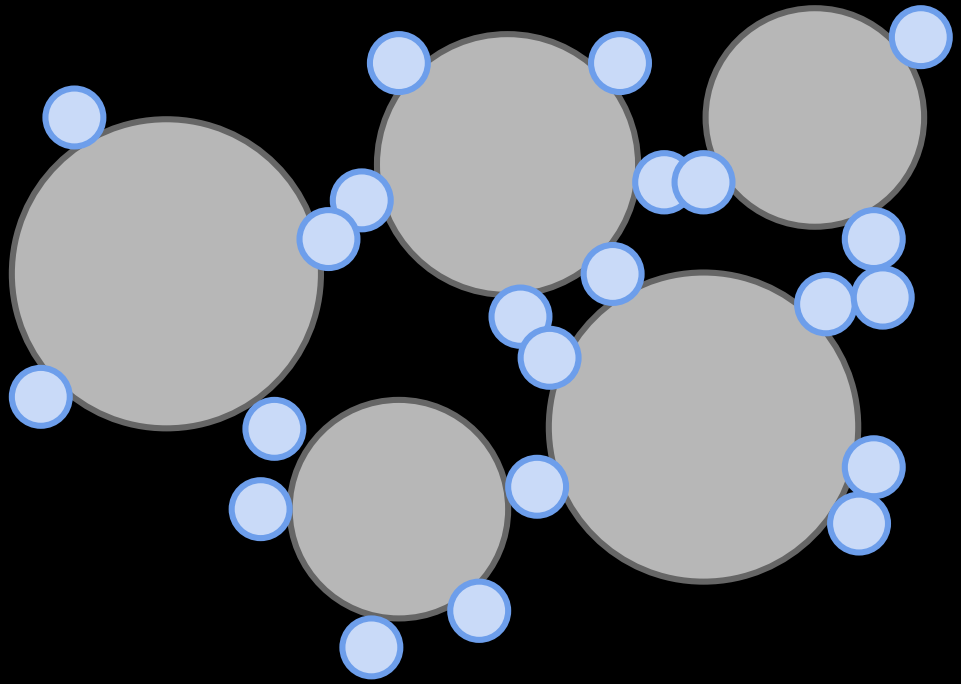
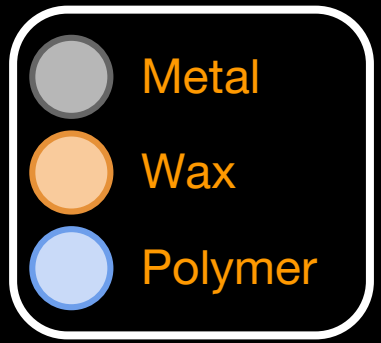
CAUTION
Keep Cover Closed At All Times Except While Loading and Unloading
Do Not Place Hands Below Coils

After Debind: Brown ADAM Part





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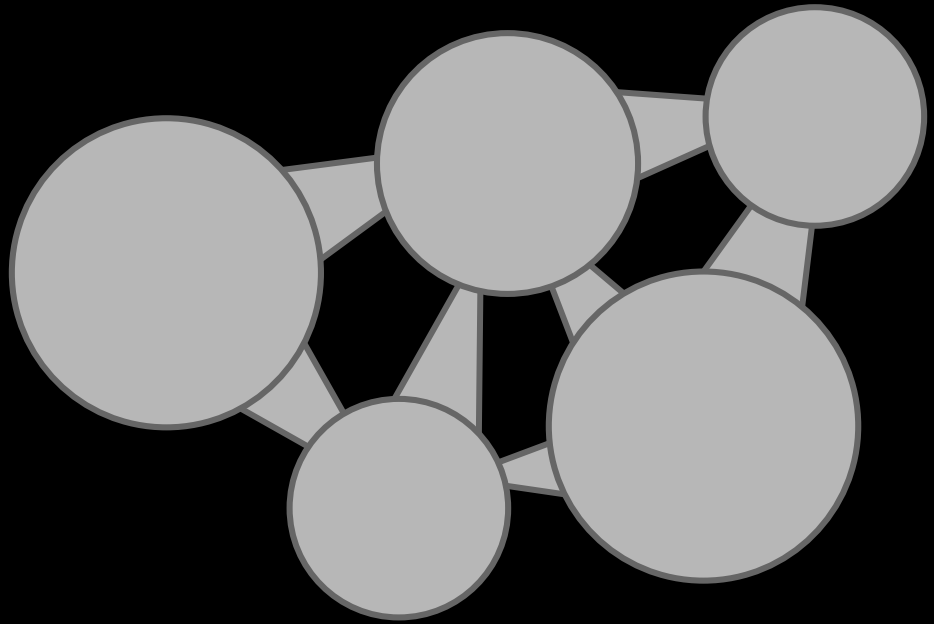
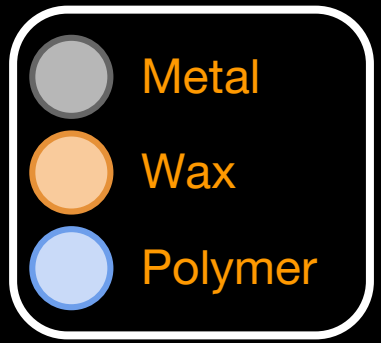
ADAM Part During Sintering





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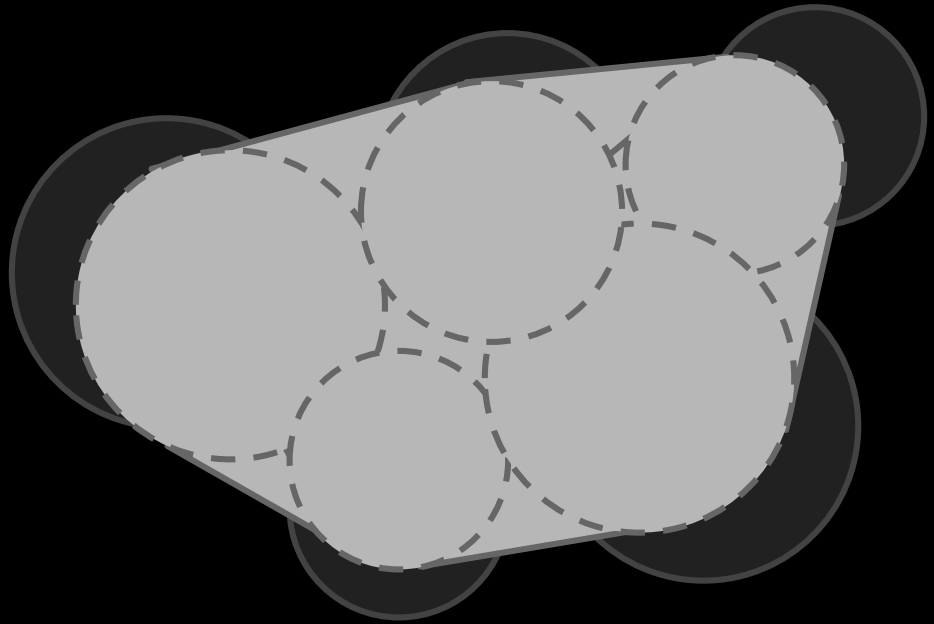
Post-Sinter ADAM Part



Metal
Wax
Polymer

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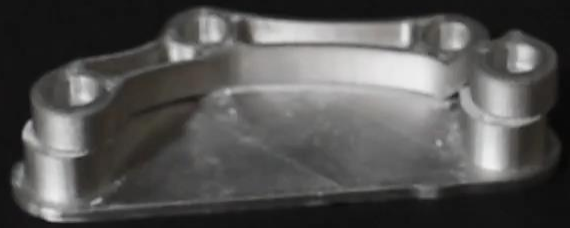
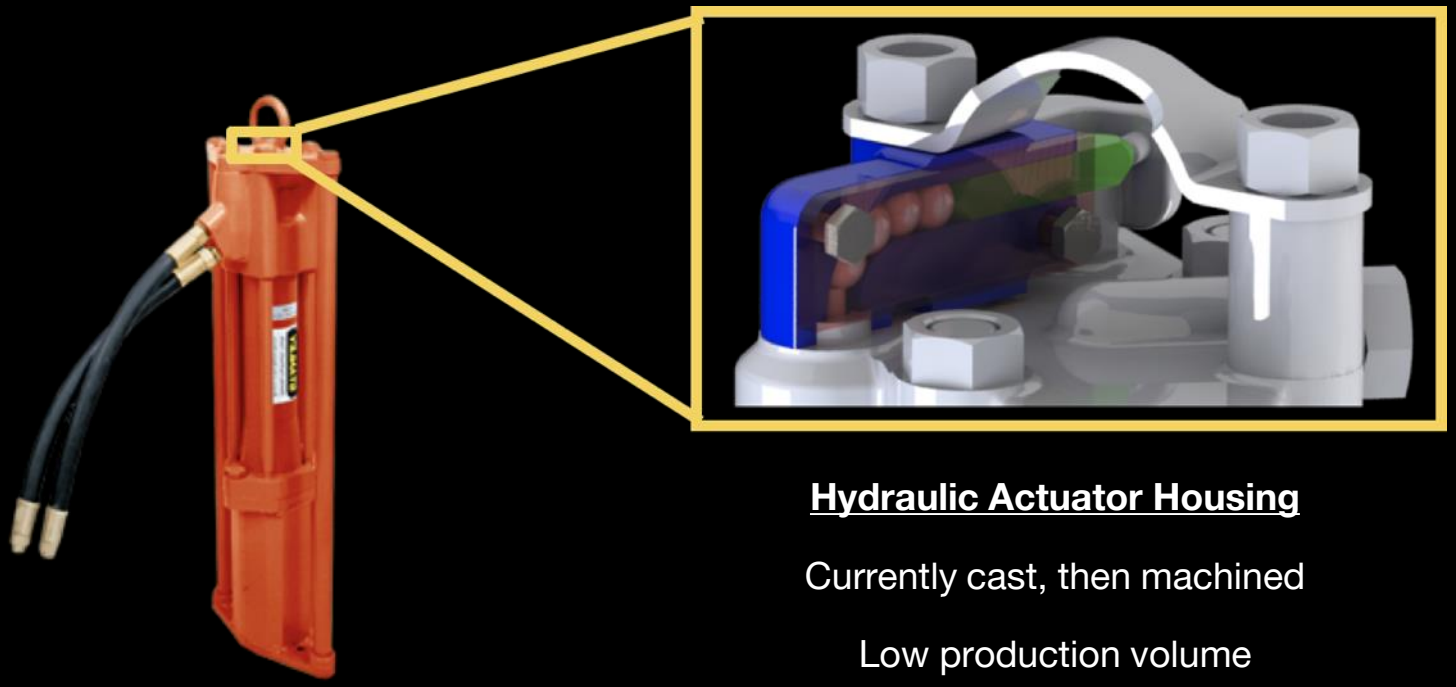


STANLEY
Infrastructure

StanleyBlack&Decker

Stanley Infrastructure – PD45 Post Driver



Hydraulic Actuator Housing

Currently cast, then machined

Low production volume

Abusive work environment

StanleyBlack&Decker

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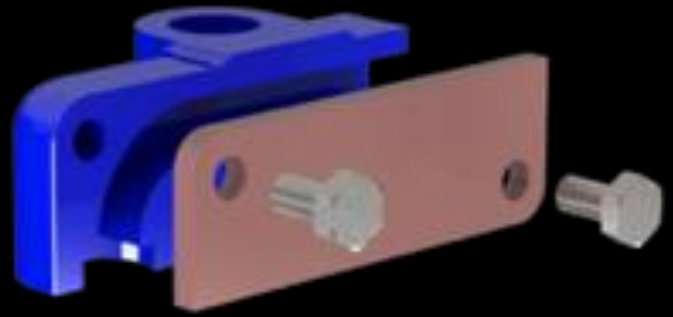
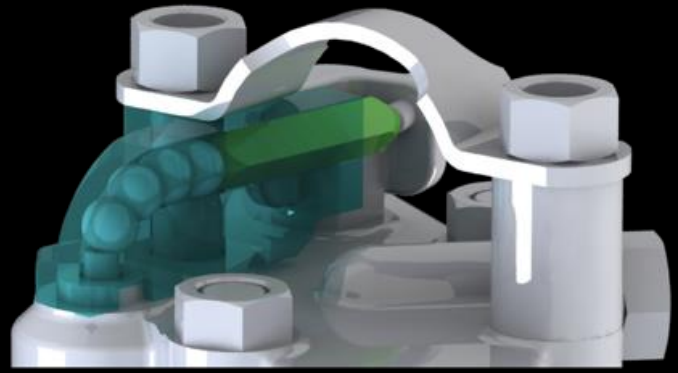
Post Driver Redesign and Testing



4 components to 1



Life Cycle	Strength	Weight
Pass	Pass	-53%

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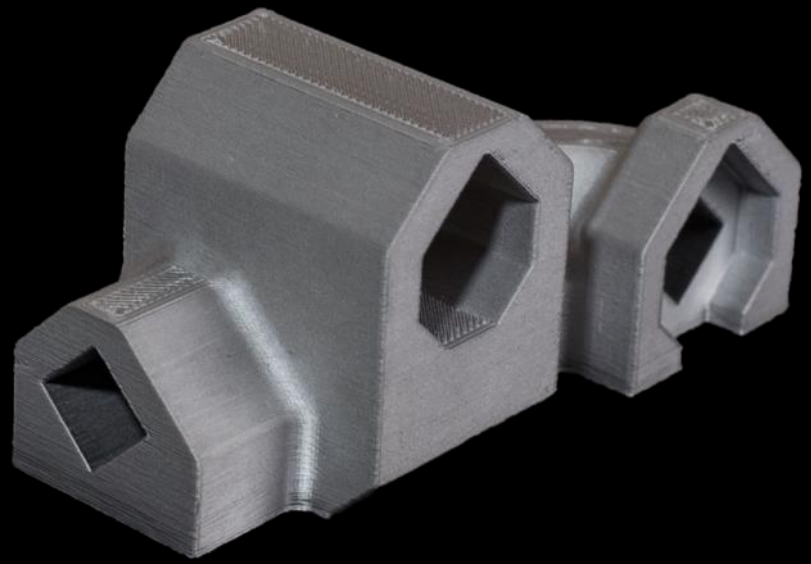
Post Driver – ROI

Production Run Model:

Cost	Lead Time
42% reduction	69% faster

Service Part Replacement Model:

Cost	Lead Time
92% reduction	95% faster



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Our customers achieve ROI in months

	Current		Markforged		Savings
Part Cost	$800	→	$80	$	90%
Labor Time	8 hrs	→	15 min		97%
Lead Time	21 days	→	1 day		95%

For the first time in history 3d printing is the lowest cost solution

Traditional Metal Printing $213

Casting $142

Markforged (today) $125

COST

VOLUME

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Industrial Service Parts is a $32B TAM

$806B

Total Industrial Equipment market by 2024

- Global Market Insights

20%

Of sales are of Service and Replacement Parts

- John Deere

~$32B

Total Addressable Market – Industrial Service Parts

- If we can print 20%

JOHN DEERE

StanleyBlack&Decker

EATON

Parker

BOSCH

Schneider Electric

CAT

Danfoss

Markforged

10th Fastest Growing Tech Company in NA

Delo

Rank	Company name	Primary industry	% growth	City	St/Prov	CEO name
1	SwanLeap	Software	77260%	Madison	WI	Brad Hollister
2	Justworks	Software	27150%	New York	NY	Isaac Oates
3	Shape Security	Software	23576%	Mountain View	CA	Derek Smith
4	Periscope Data	Software	23227%	San Francisco	CA	Harry Glaser
5	Arrowhead Pharmaceuticals, Inc.	Biotechnology/pharmaceutical	17847%	Pasadena	CA	Christopher Anzalone
6	Viveve Medical, Inc.	Medical devices	16887%	Englewood	CO	Scott Durbin
7	iLearningEngines	Software	14848%	Bethesda	MD	Harish Chidambaran
8	Exact Sciences Corp	Biotechnology/pharmaceutical	14694%	Madison	WI	Kevin Conroy
9	Podium	Software	13381%	Lehi	UT	Eric Rea
10	Markforged	Electronic devices/hardware	12687%	Watertown	MA	Gregory Mark
11	COLO-D	Software	10942%	Drummondville	QC	Patrick David
12	BioCatch	Software	10451%	New York	NY	Howard Edelstein
13	Reflektive	Software	8240%	San Francisco	CA	Rajeev Behera

Forbes

Markforged

Founders: David Benhaim, Greg Mark (CEO)
Equity Raised: $57 million
Estimated 2018 Revenue: $70 million
Lead Investors: Matrix Partners, Siemens, North Bridge Venture Partners, Next47

Markforged makes 3-D printers. When Greg Mark founded the company in 2013, most 3-D printer companies were cranking out resins and plastics. He focused, instead, on carbon, which is stronger and more suitable for a variety of industrial uses. Today, the company—one of a number of 3-D printing startups—makes printers for both carbon and metal. "Plastics are not strong enough for industrial tooling," Mark says. "You can get strong parts in an affordable price in carbon fiber. It is the factory of the future."

Markforged

Our Investors

Markforged investors include leading venture capital firms and industry leaders in technology, automation, and automotive.

Questions