Le frontiere della produzione di massa attraverso la manifattura additiva: AM 2.0

Desktop Metal

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Desktop Metal History

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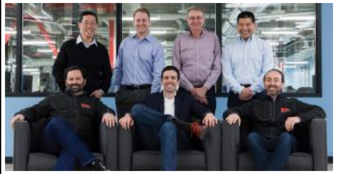
Desktop Metal™ is founded by Ric Fulop alongside leaders in collaboration with world-leading experts in materials science, engineering, and 3D printing.



Over the course of two years, their work pulls multiple independent inventions together to form the DNA for Desktop Metal's technology.

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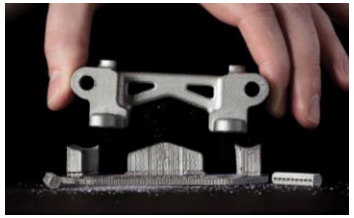
[APR] Desktop Metal is officially launched with the introduction of the Studio System, the world's first office-friendly metal 3D printing system, and the Production System, the world's fastest mass production printer.

[DEC] Desktop Metal **begins shipping Studio System** to pioneer customers. The first to receive a printer is Google's ATAP.



[NOV-DEC] Desktop Metal is awarded two seminal **Separable Support patents** for its metal 3D printing technology

18

$227M

MAR] Desktop Metal announces **Series D follow-on funding**, led by Ford and Future Fund, bringing the company's total funding to date to $277M; analysts place valuation of the company at $1.1 billion

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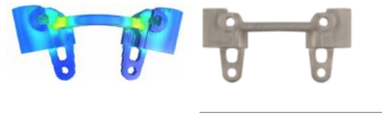
[MAR] Shipment and installation of first ever **Production System**

[OCT-NOV] Desktop Metal introduces **Fiber**, the world's first desktop 3D printer to fabricate high resolution parts with continuous fiber composite materials used in automated fiber placement processes. And **Shop System**, the world's first metal binder jetting system designed for machine shops and metal job shops.

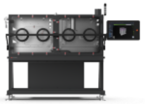
20

DM
LISTED
NYSE

[DEC] Desktop Metal goes public via SPAC merger becoming the world's only publicly traded pure-play additive manufacturing 2.0 company



[NOV] Desktop Metal announces the debut of **Live Sinter**, a Dynamic sintering simulation software.



[DEC] Desktop Metal expands the Production System lineup with the addition of the **P-1 Printer** designed to bridge process development and full-scale metal parts mass production

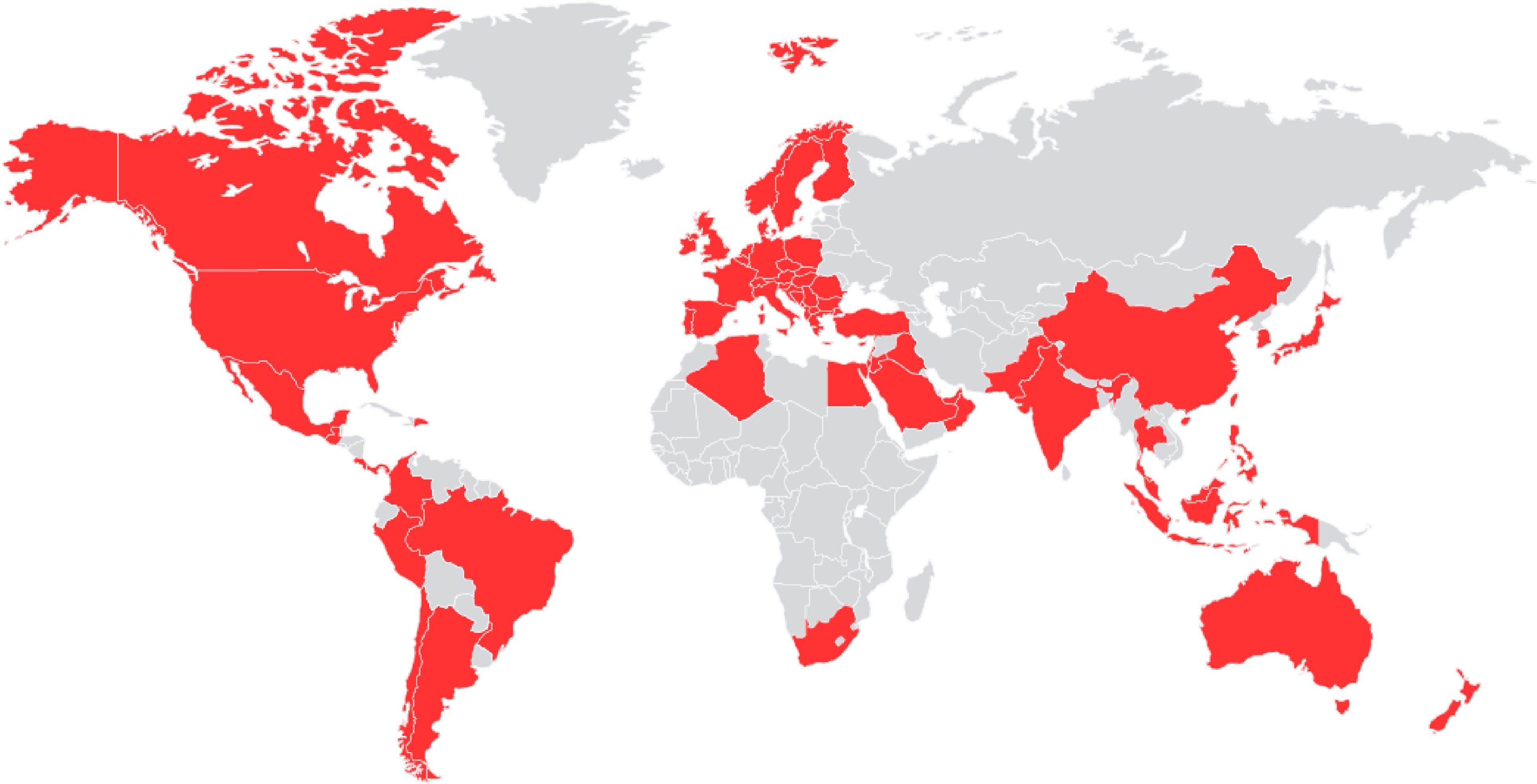
21

[JAN] Desktop Metal **launches the Studio System 2**, delivering two-step, office-friendly metal 3D printing.

envisionTEC

[FEB] Desktop Metal acquires EnvisionTEC entering market for volume production polymer additive manufacturing

Distribution and local support in 60+ countries around the world



The additive manufacturing industry is at an inflection point

Approaching the next generation of technology: Additive Manufacturing 2.0

Volume production of end-use parts

- Finish
- Accuracy
- Properties
- Low-cost
- High-speed

Additive Manufacturing 2.0 will be driven by:

Accessibility

- Parts that used to be too expensive or difficult to print can now be justified with new low cost, accessible 3D printing technologies

High Volume Manufacturing

- What used to be a niche manufacturing process to produce one or a handful of parts can now be used to produce end use parts in high volume

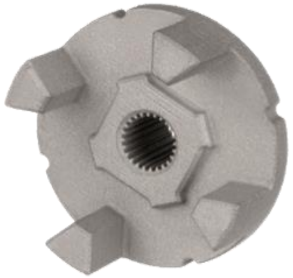
AM 2.0 - Metals

At-scale with comparable quality, speed, and cost of legacy processes

Finish

—

Meeting or exceeding end use part requirements



Accuracy

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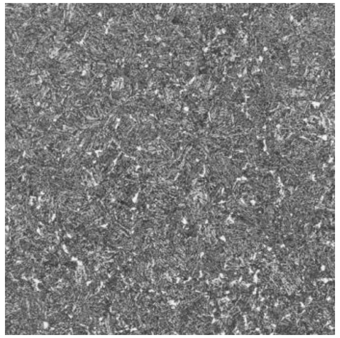
Similar to casting or MIM



Properties

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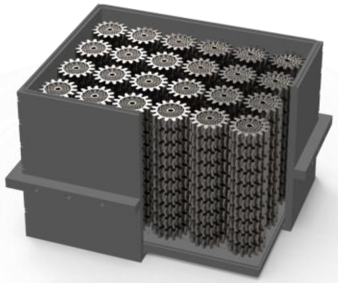
Isotropic and meeting or exceeding standards



Cost & Speed

—

Equal or better than CNC and casting

Introduction to binder jetting

Binder jet is a key technology for mass production

Binder jetting has emerged as a key technology for mass production of metal parts using 3D printing, given its cost and throughput advantages relative to laser powder bed fusion (LPBF) technology.

- High throughput production via raster-based printing
- Low cost material inputs from established supply MIM chain with a broad portfolio of materials
- Attractive part costs across an array of applications
- Design flexibility
- Isotropic material properties
- Scalable to large build boxes sizes & large parts
- Low-waste process with re-usable material inputs

What is binder jetting

Binder jetting is an additive manufacturing powder metallurgy process in which a liquid binding agent (or “binder”) is selectively deposited onto a powder bed to bond powder particles together and form a solid part one layer at a time. Commonly used materials in binder jetting include metals, sands, and ceramics.

To date, metal 3D printing has barely scratched the surface.

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For Prototyping and Tooling,
it's been too industrial and expensive.

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For Volume Production,
it's not fast or cheap enough.

These challenges led to limited applications

- High part cost tolerable
- High tolerances required
- Excellent material properties required

- **Limited applications:** specialized, not cost-sensitive, relatively low volume parts

Aerospace

Borescope eye for geared turbofan

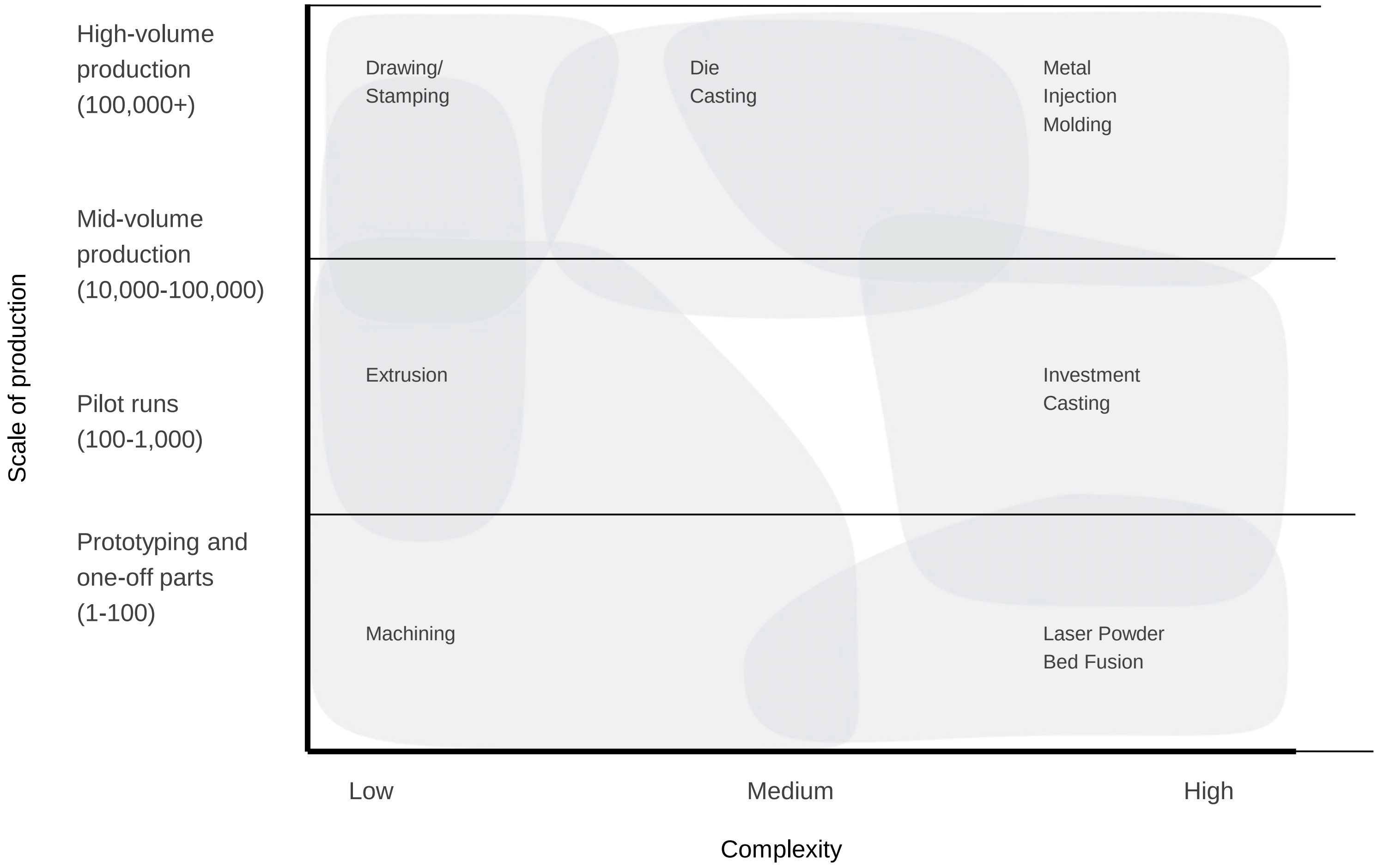
Medical

Orthopedic hip implant

It’s time for the next generation of metal 3D printing: AM 2.0

Metal Additive vs. Traditional Methods

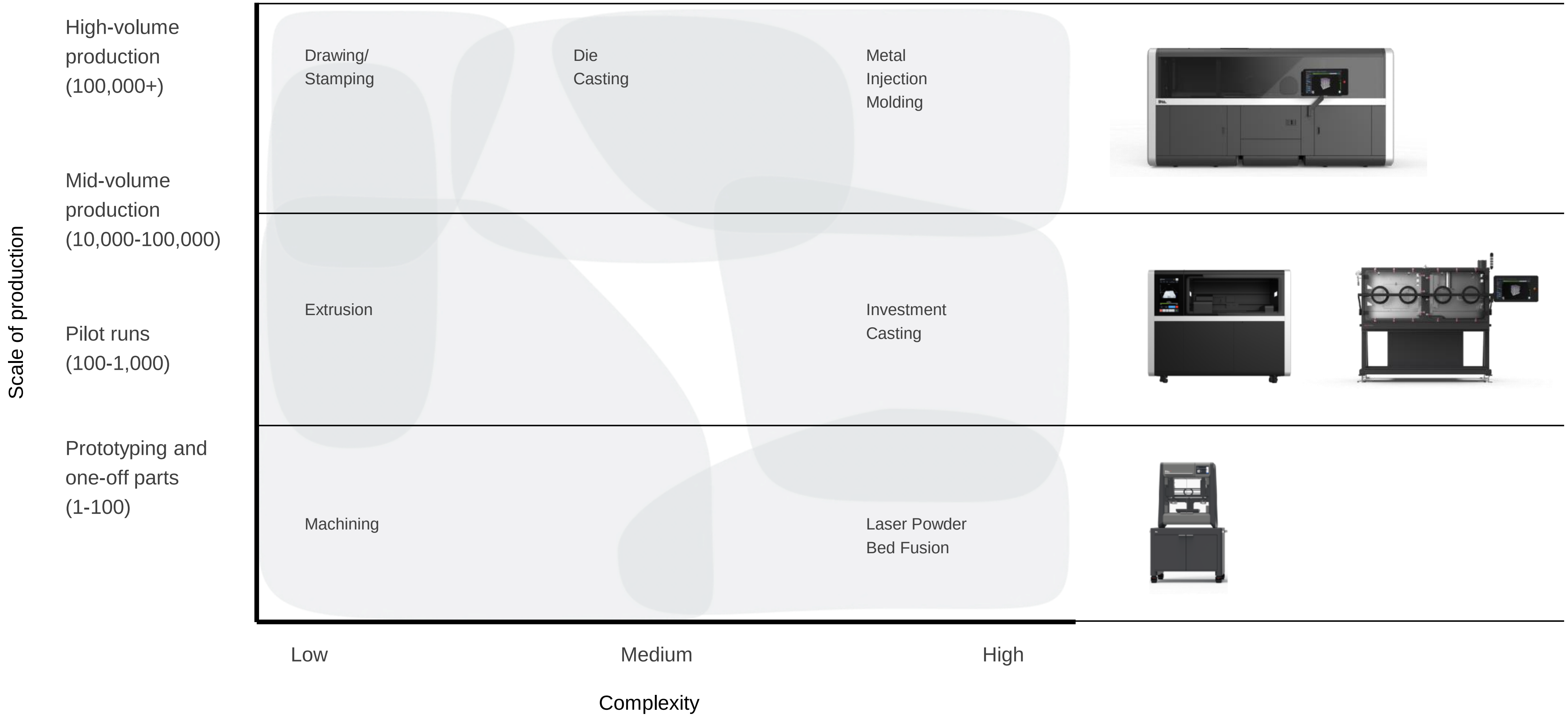
Manufacturing Technologies Complexity



- Months to bring a production line up
- Less design iteration
- Sacrificing design optimization for ease of manufacturing
- For Powder Metallurgy only high quantities can be justified to amortize tooling

Tooling-free manufacturing

Desktop Metal systems unlock speed, cost, and performance benefits at any scale and any level of complexity



Turnkey solutions offer easy entry into industrial 3D printing while open-platform, high-volume systems deliver low part costs

Continuous Fiber

Fiber™

Continuous fiber-reinforced parts with aerospace-grade AFP tape.

Metal in office

Studio System™ 2

Turnkey, office-friendly production of metal parts in-house.

Metal in production

Shop System™

Turnkey batch production of fully dense customer-ready parts. Designed for machine shops

Production System™ P-1

Open-platform, highly tunable system for cost-effective serial part production. Development bridge to mass production with the P-50.

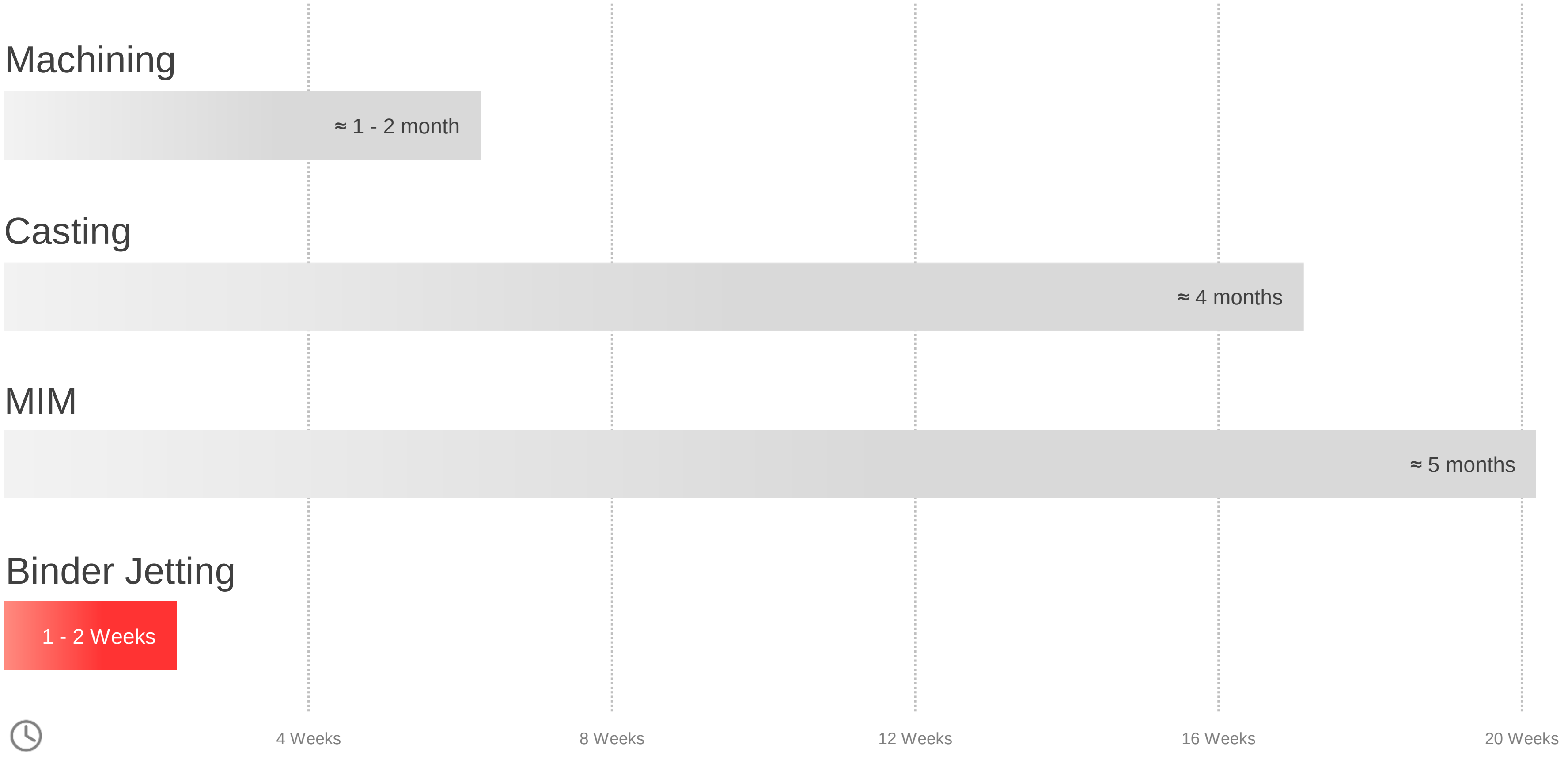
Production System™ P-50

High-speed, mass production of metal parts, designed for the factory floor.

Ease of use with automated workflows and turnkey solutions

Volume production with attractive part economics

How does Binder Jetting compare?



Binder Jetting

01_Prep (≈1 day)

- Support Design
- Build Preparation

02_Pilot Production (≈4 days)

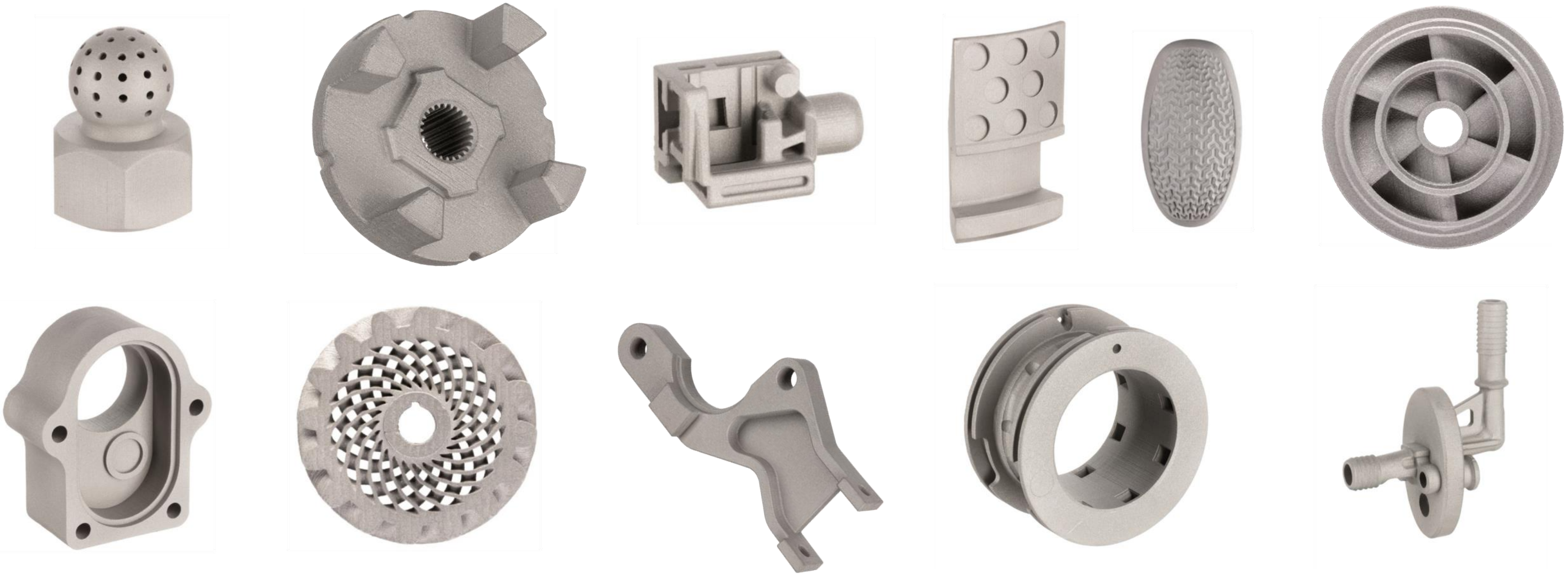
- Pilot Print
- Crosslink
- Depowder
- Sinter

03_Production (≈1 week)

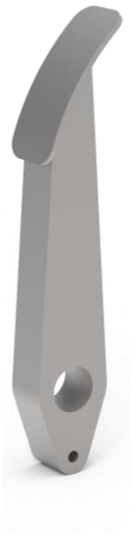
- Customer Approval
- Volume Production

What happens if the design changes?

To produce high-resolution parts without tooling



Enabling product innovation from design phase through to mass production



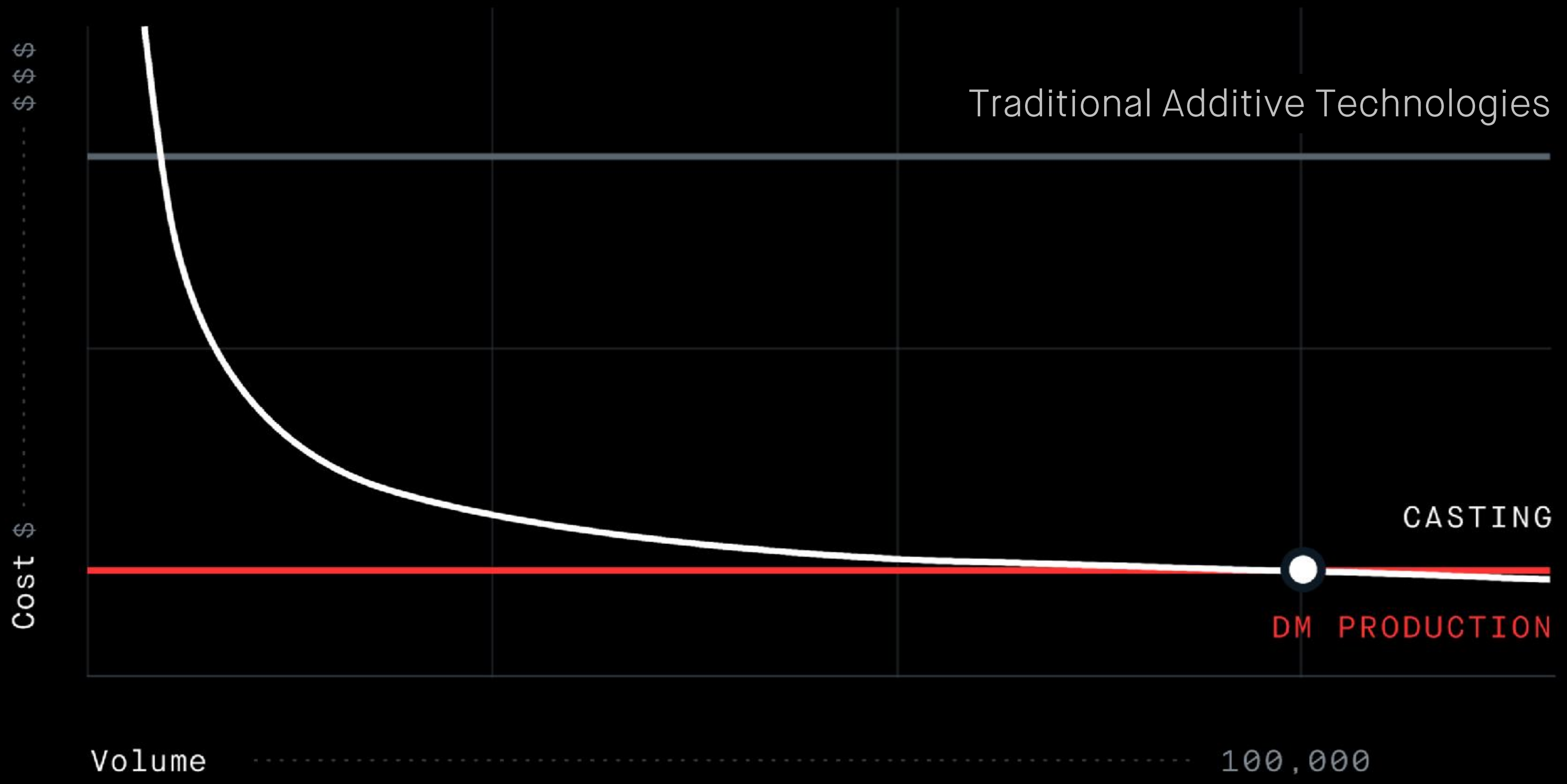
Original Design: 1,325g

Additive Manufacturing Design: 586g

Now possible to mass produce with Binder Jetting

Design & Prototyping | Optimization | Mass Production

Competitive **Cost-per-part**

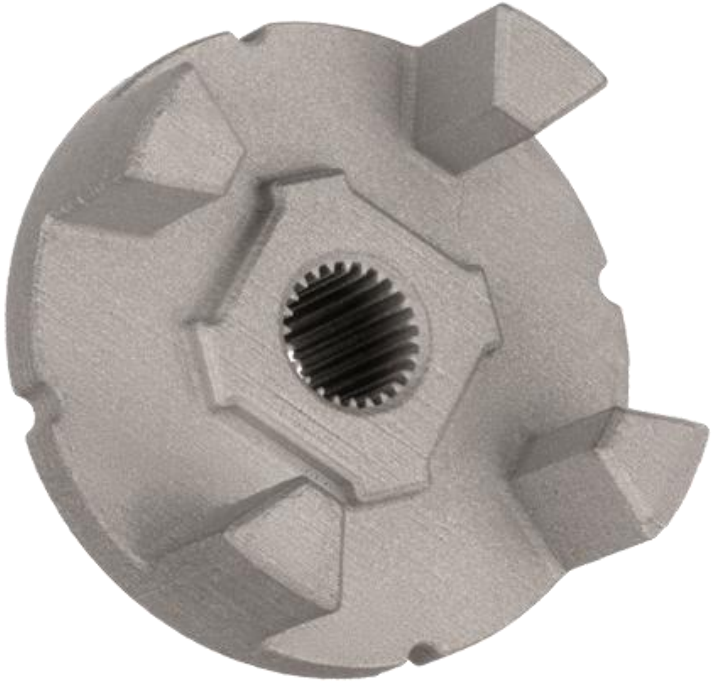


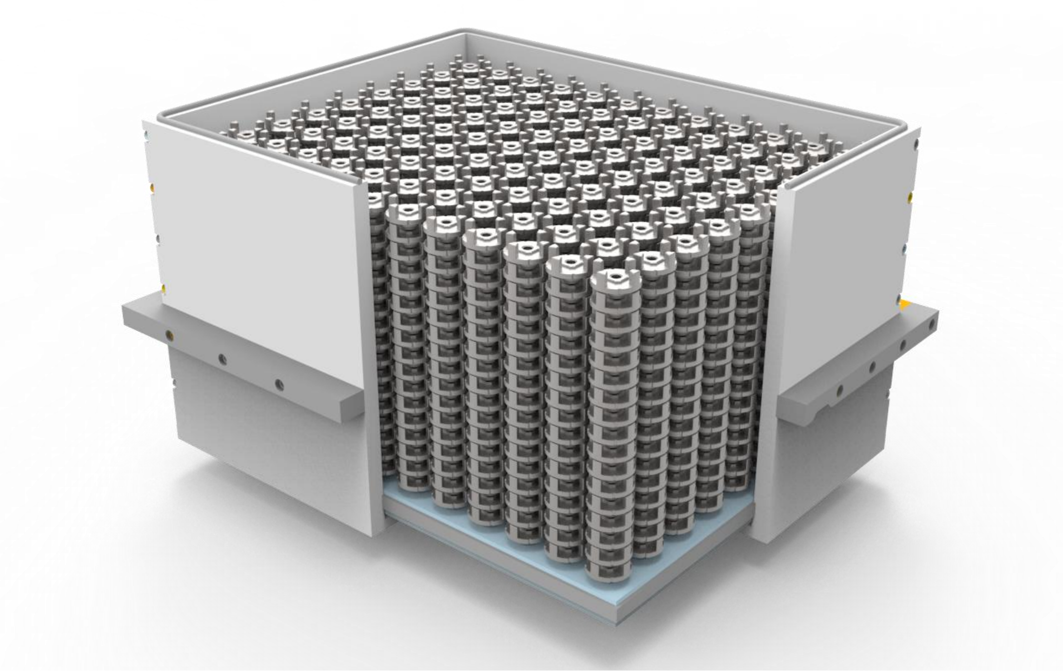
Part Name

Power Steering Joint

Brief Description

This joint is designed to transfer power from an electric motor to the steering wheel





Material	Size
17-4 PH	36 x 36 x 22 mm

Cost / Part	Parts / Build	Throughput / Year
$2.52	646	1,206,471

Desktop Metal™ Production System™

Costing and throughput for P50 Production System
48L Build Volume, 75 um layer height, 80% of 24x7 utilization, fully burdened

Part Name

Fuel Swirler

Brief Description

This swirler is used to push the fuel mix into the burner.

Material

17-4 PH

Size

30 x 30 x 10 mm

Cost / Part

$4.95

Parts / Build

641

Throughput / Week

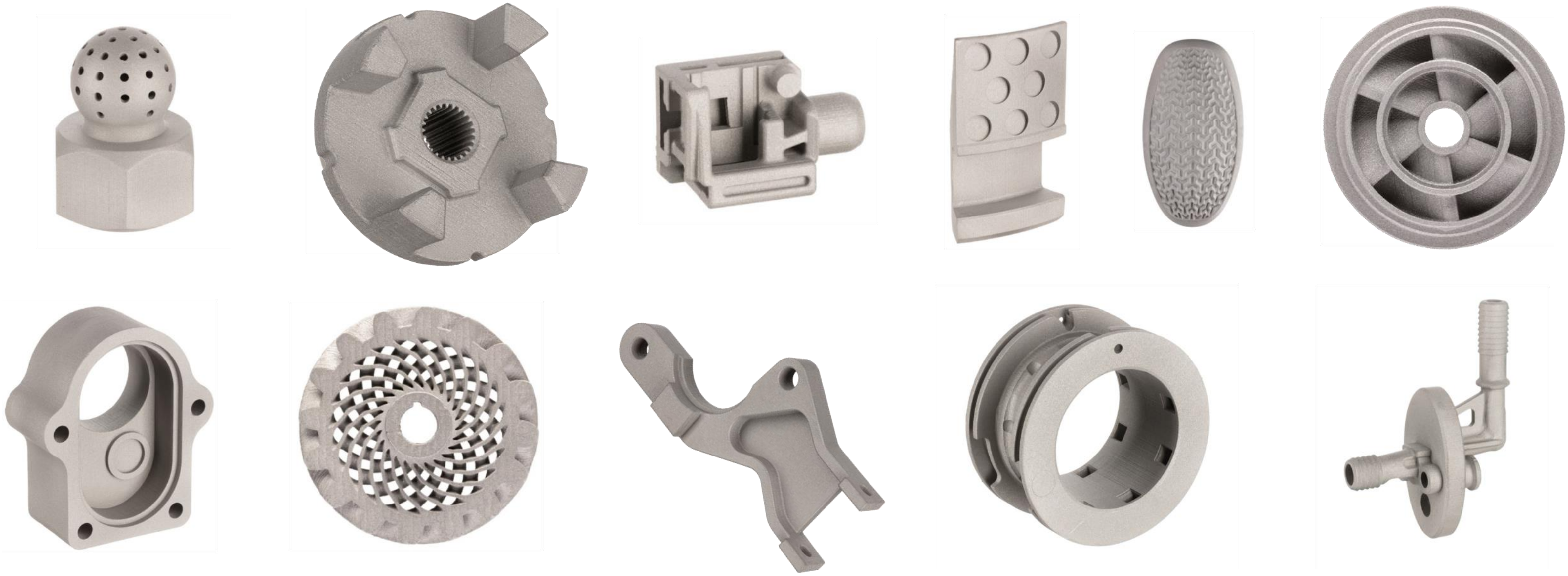
5,761

Desktop Metal™ Shop System™

Costing and throughput for Shop System
16L Build Volume, 100 um layer height, 80% of 24x7 utilization, fully burdened

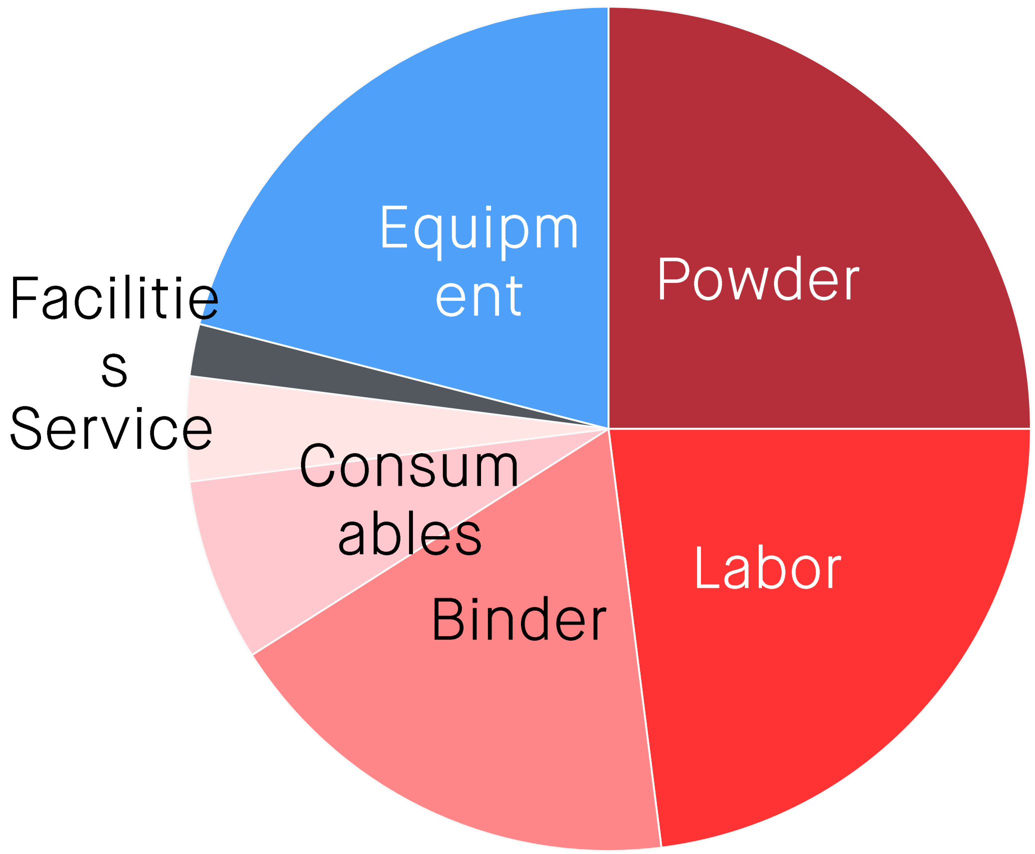
Cost Model

3D printing on the manufacturing floor: volume production with no tooling!



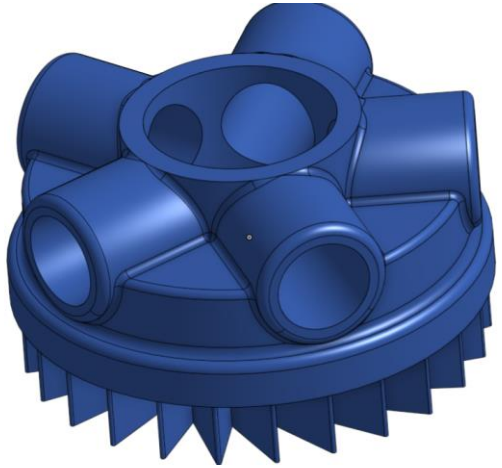
What goes into part cost?

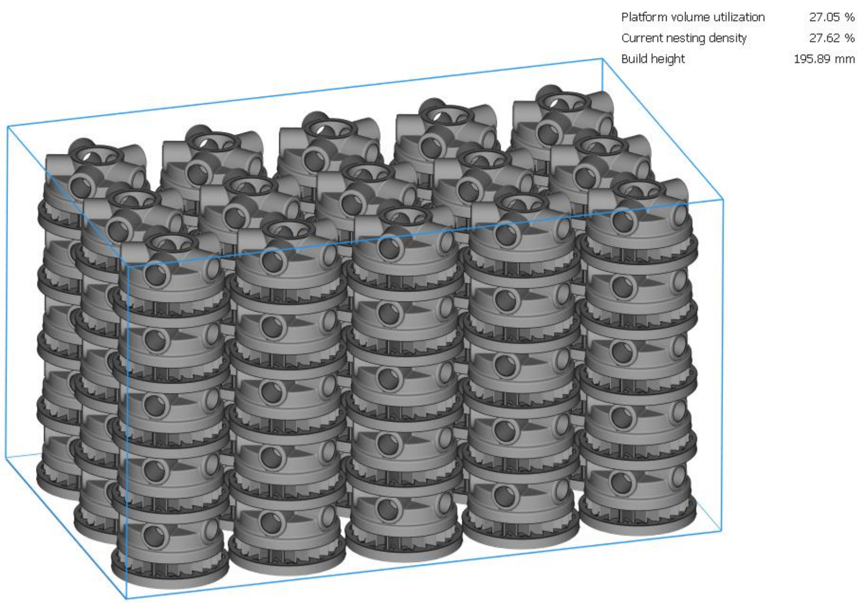
- Operating costs — full process
  - Raw materials (binder & metal powder)
  - Machine consumables (printheads, etc.)
  - Utilities (gas & electric)
  - Labor (@ default of $30 / hr)
  - Equipment service
- Equipment costs
  - Depreciation (@ default of 3 years)



Rotating manifold

- Machining requires multiple set-ups
- Part information
  - Pre-scaled dimensions: 50 x 50 x 27 mm
  - Pre-scaled volume: 24,148 mm3
  - Parts per 16L build: 75
  - Parts per week: 214
  - Parts per year: 11,115





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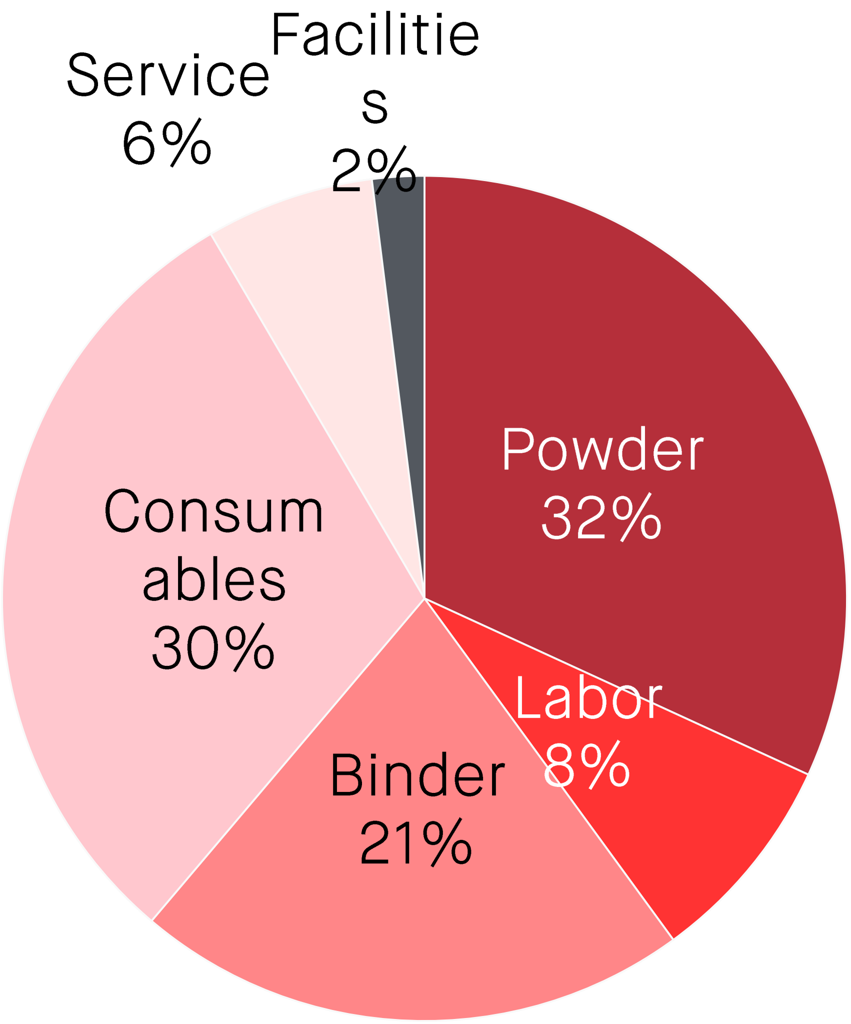
- Part costs
  - Excl. depreciation: $50.20



[1] Key assumptions: 4L build volume; 17-4PH material; 75 micron layers; 24x7 at 80% utilization; labor at $30/hr

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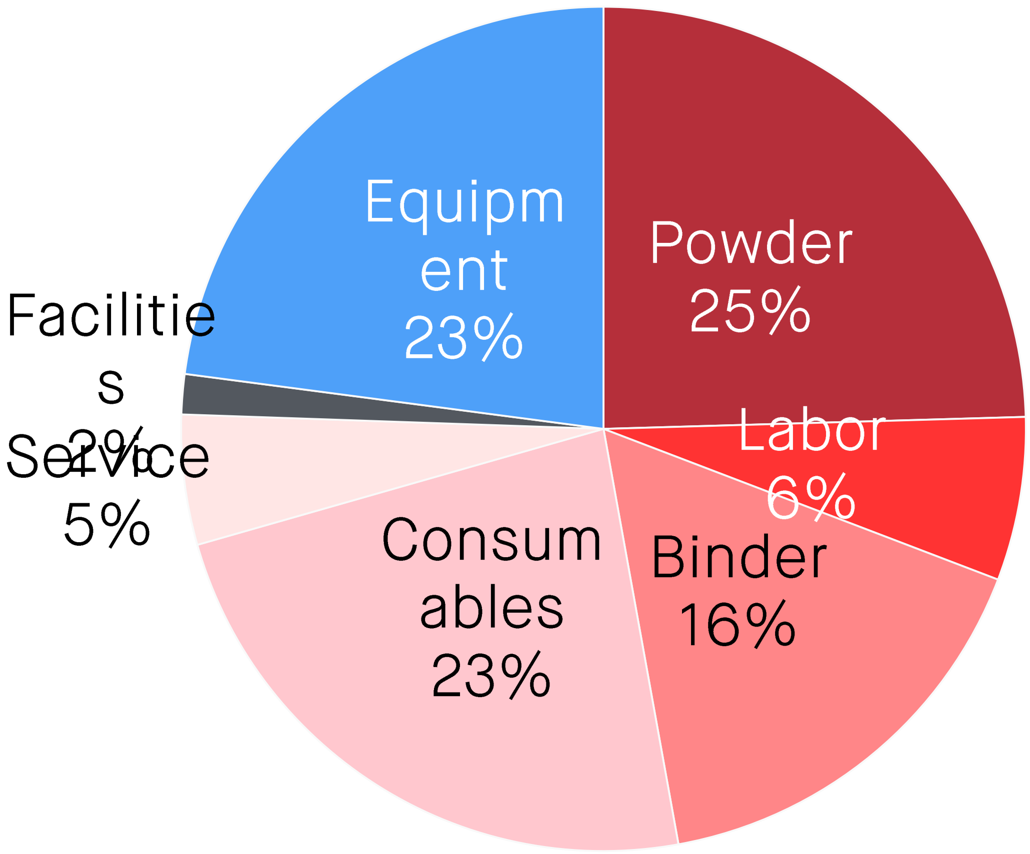
- Part costs
  - Excl. depreciation: $50.20
  - Incl. depreciation: $65.13 ($2.70 per cc)

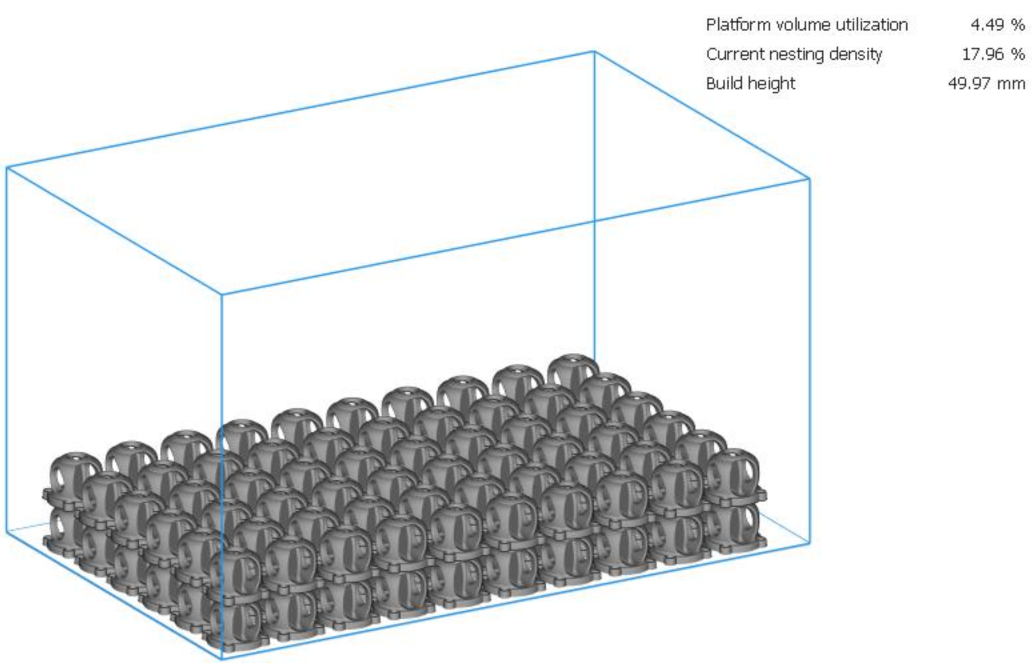


Desktop Metal

[1] Key assumptions: 16L build volume; 17-4PH material; 75 micron layers; 24x7 at 80% utilization; labor at $30/hr; 3yr depreciation

Swivel base

- Very difficult part to manufacture via casting or machining
- Part information
  - Pre-scaled dimensions: 25 x 25 x 19 mm
  - Pre-scaled volume: 3,287 mm3
  - Parts per 4L build: 120
  - Parts per week: 1,140 [1]
  - Parts per year: 59,280 [1]



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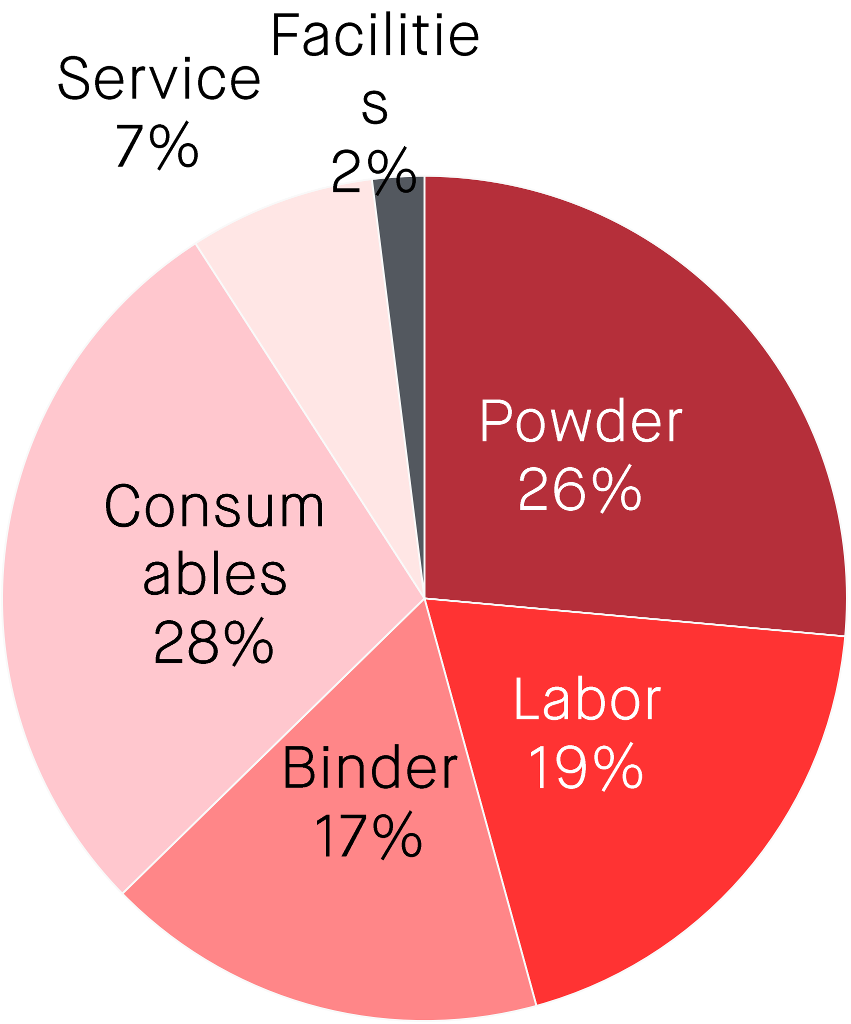
- Part costs
  - Excl. depreciation: $8.55



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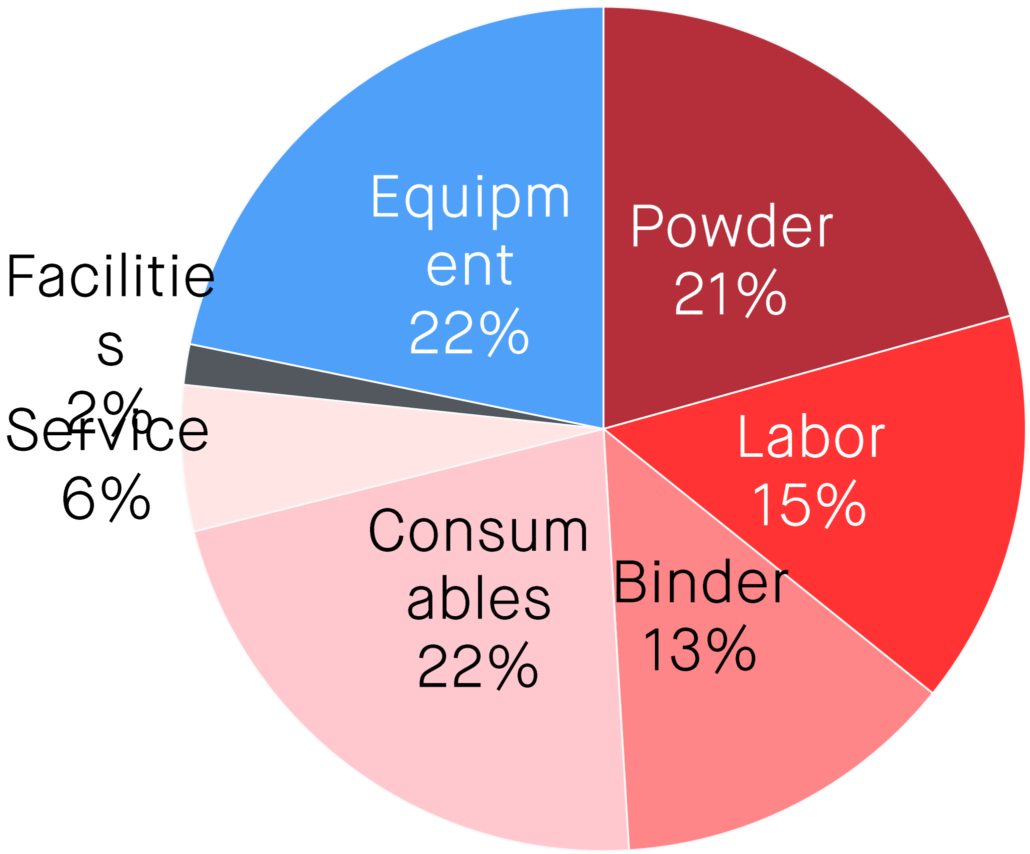
  - Incl. depreciation: $10.92 ($3.32 per cc)



Desktop Metal

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Shop System™ economics vs. Production System

	Shop System	Production System
Throughput (parts / week)	~100 - 1,000	~10,000 - 50,000
Max speed	Up to 800 cc/hr	Up to 12,000 cc/hr
Average process time (end-to-end)	3 - 4 days	2 days
Sintered cost / cc (17-4PH) [1]	~$2.00 - $5.00	~$0.25 - $0.75
Build volume	350 x 220 x 200 mm (up to)	490 x 380 x 260 mm
Surface roughness	4 µm Ra <0.1 µm Ra with mass finishing	4 µm Ra <0.1 µm Ra with mass finishing
Resolution	16 µm voxel	21 µm voxel
Facilities requirements	Yes	Yes
Part anatomy	Fully dense	Fully dense

[1] Part cost estimates are fully burdened, including materials, consumables, equipment depreciation, service, labor, and utilities.