

Additive in Automotive

Applying 3D printing to
overcome supply chain
challenges

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Strategic Application Engineering
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- 1– Supply Chain Challenges
 - _ Part Cost
 - _ Logistics Cost
 - _ Responsiveness Cost
- 2– Successful Implementation
- 3– Example Applications
- 4– Markforged Background
- 5– Questions



Supply Chain - Part Cost





Manufacturing

Economies of scale dictates tool originates at single manufacturing site

6-8 weeks

\$500-\$1000



Distribution

3rd party shipping/logistics service ships to regional hubs

1-2 weeks

\$150-\$250



Regional Hub

Inspect and log new tools to inventory, distributing to dealers as needed

1 week

\$10-\$20



Regional Shipping

Shipping/courier services deliver tool to final location

1 weeks

\$10-\$50



Service Site

Tool finally arrives at desired location

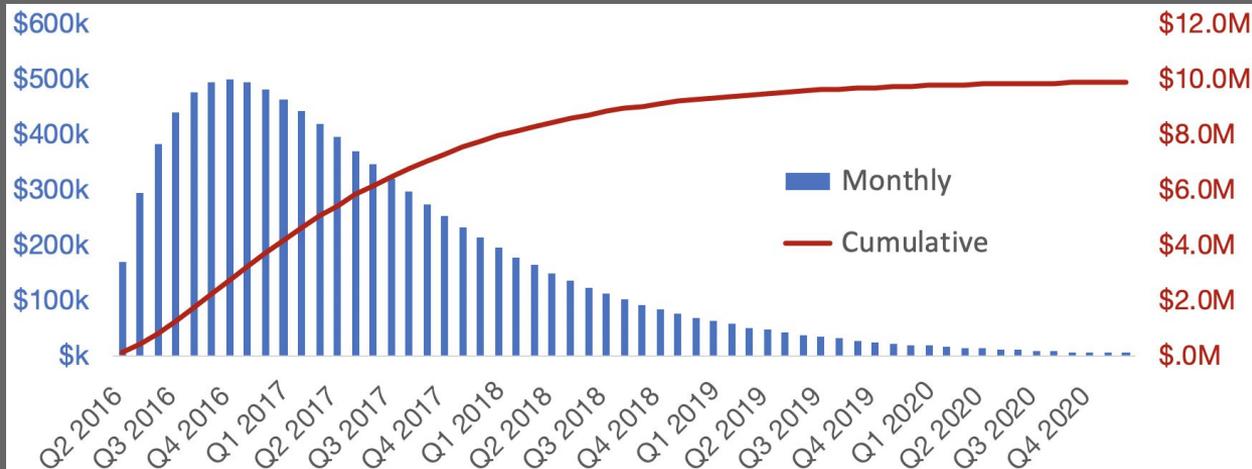
9-12 weeks

\$670-\$1320



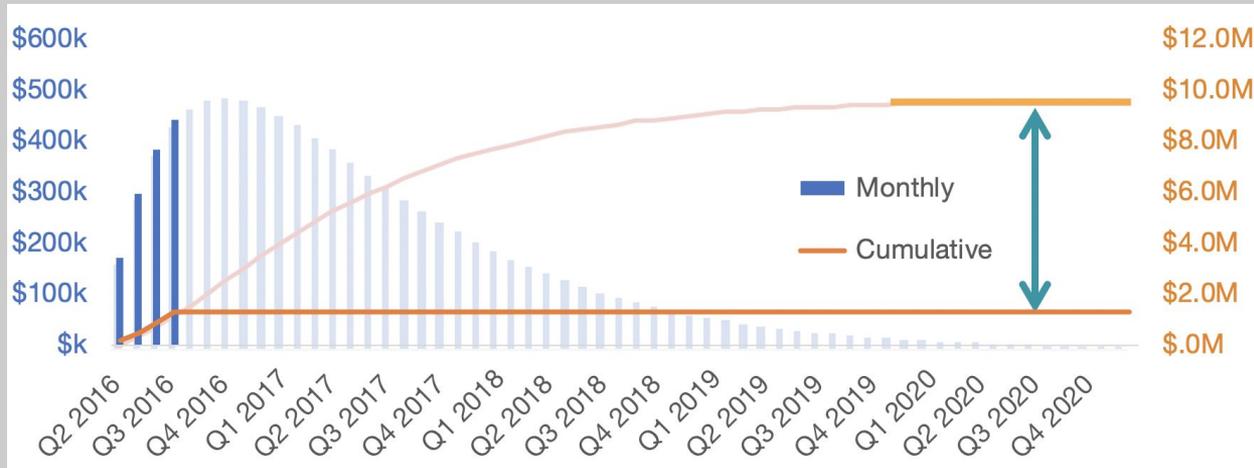
Impact study. Factory defect.

- _ Change in manufacturing process results in a serious defect after product is in market
- _ Solution and replacements are engineered. Deemed too expensive to solve globally
- _ Without deploying a permanent fix, repairs are ongoing and often require multiple service visits

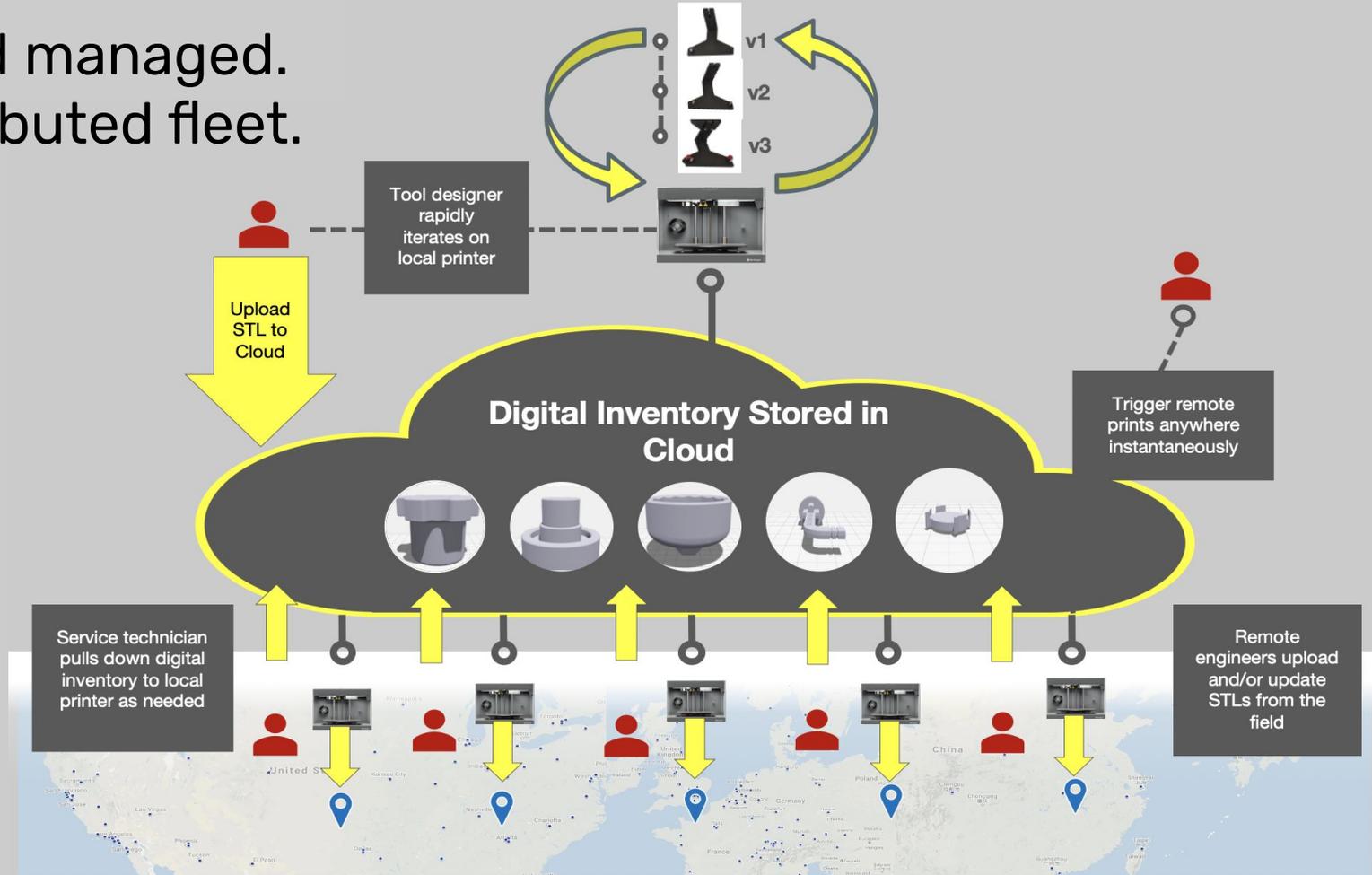


Impact study. Factory defect.

- _ Design solution quickly iterated
- _ Replacement tooling quickly deployed at scale
- _ Improved customer experience in addition to substantial cost savings

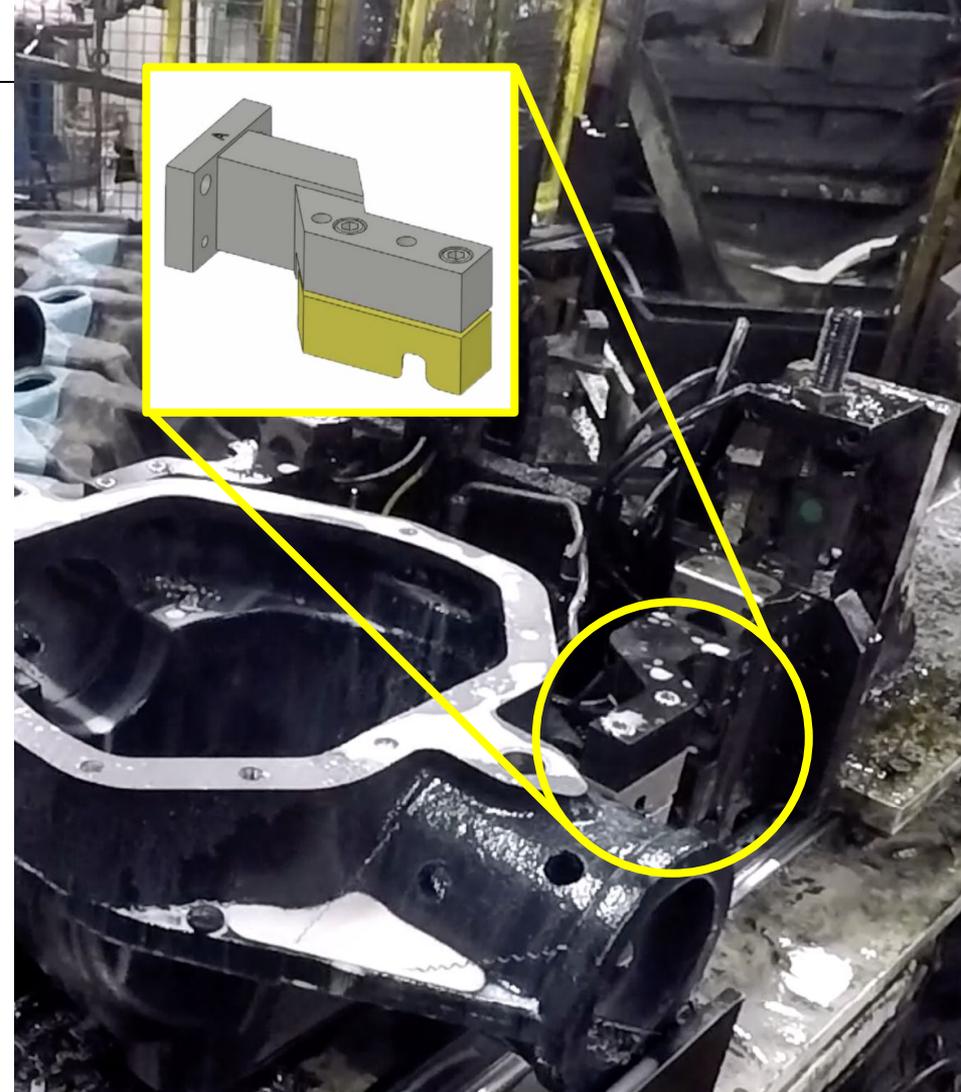
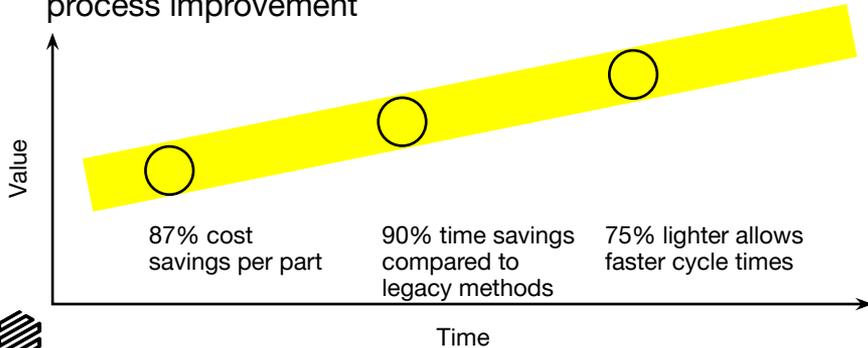


Cloud managed. Distributed fleet.



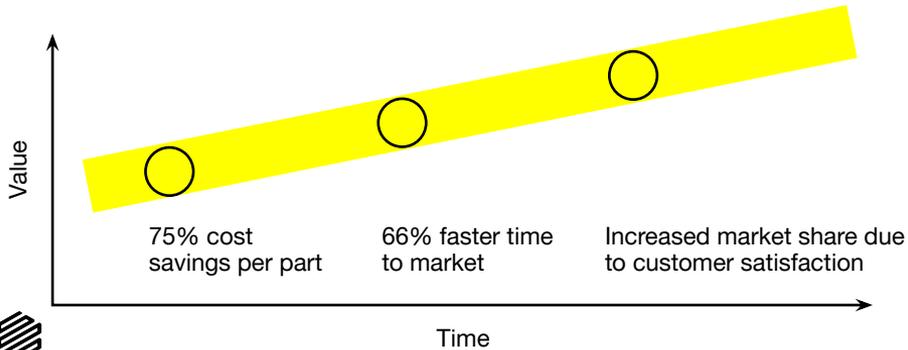
Hybrid metal/composite. Industrial performance.

- Resists harsh environment
- Light weight allows single operator changeovers
- Increased resistance against damage and downtime
- Wide design flexibility enables process improvement



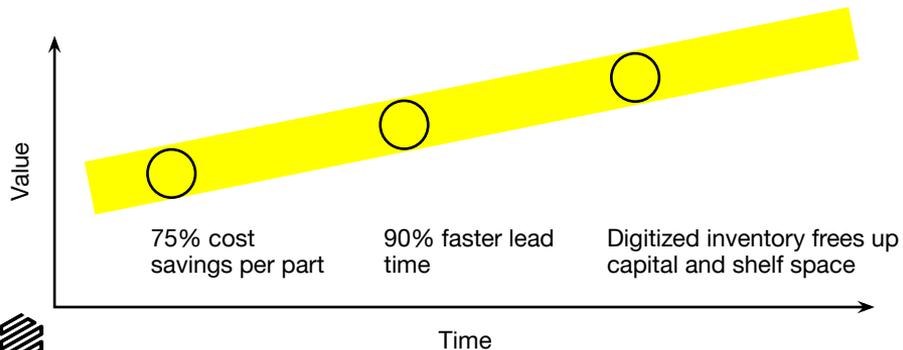
Downtime driven. Preferred for production.

- Meets functional requirements
- Faster pathing and improved chip clearing
- Lighter tool means faster machining cycle time



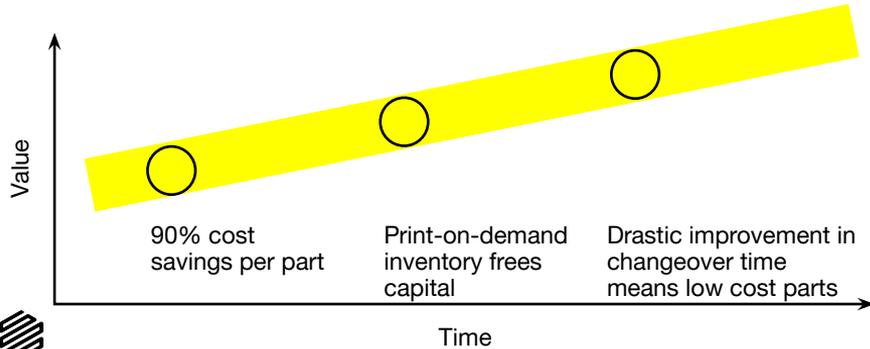
Functional equivalence. Complex internal geometry.

- Validated in production testing
- Integral channels for cooling and shielding gas
- Print-on-demand allows rapid expansion of value proposition across locations



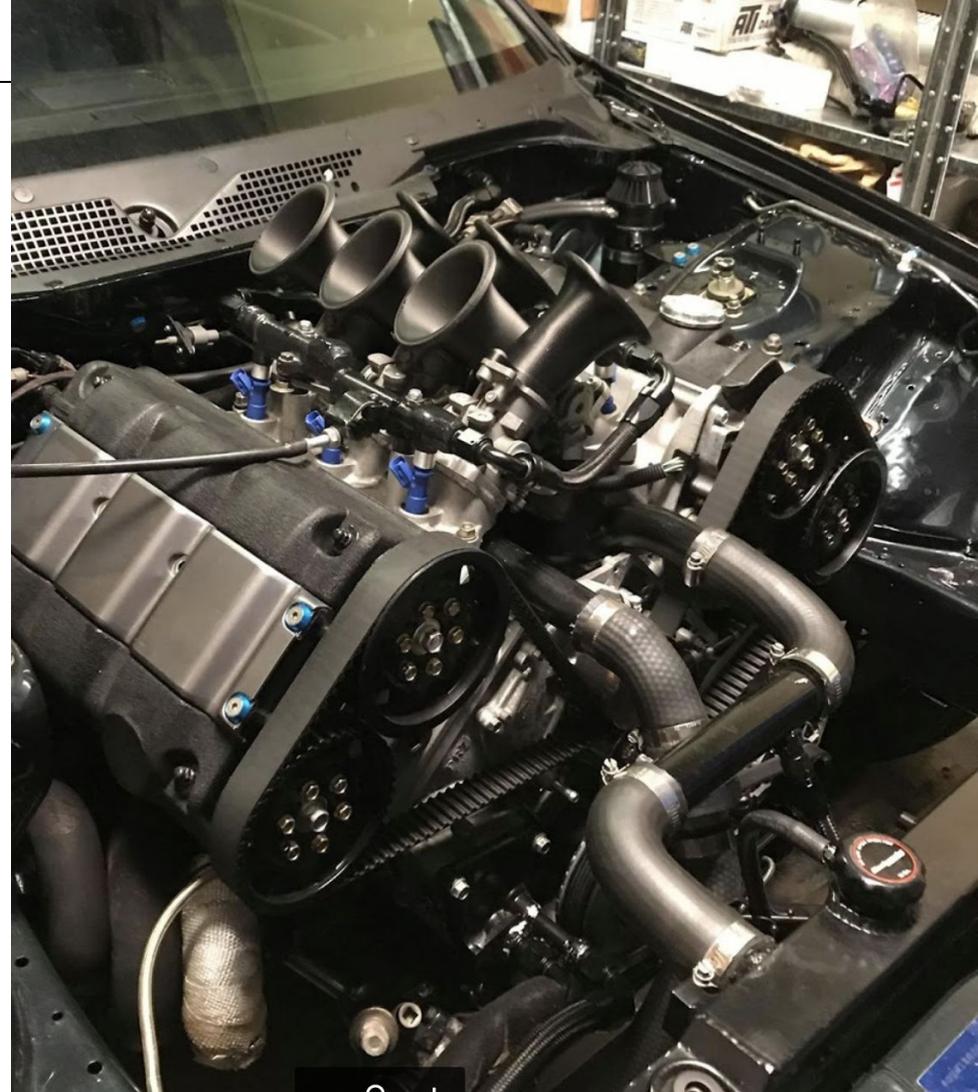
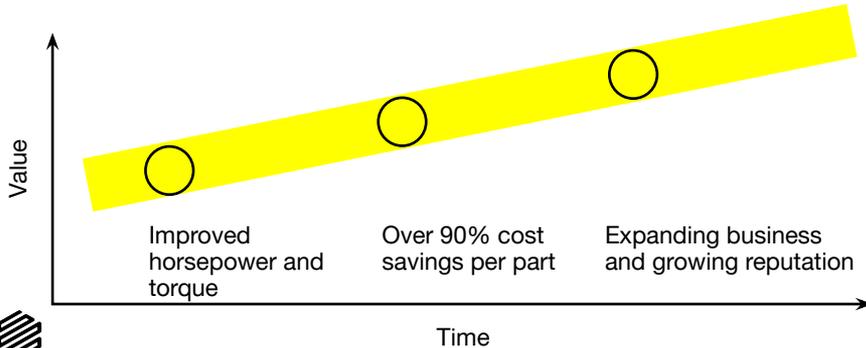
Conformal cooling. Repeatability.

- Exceeds conductivity requirements
- Integral cooling and quenching paths
- Multipart assembly reduced to one
- Reduced variability in performance



Higher performance. Increased satisfaction.

- Survives under-hood environments
- Improved performance over stock
- Customization and customer responsiveness
- 350 unique parts in inventory now managed digitally



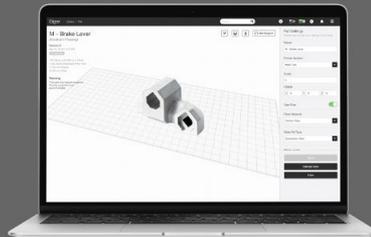
Why Markforged?

- _ Single user experience to access a complete set of materials & capabilities
- _ Closed-loop calibration process control for Accuracy & Repeatability
- _ Purpose built materials engineered to deliver superior strength, accuracy, and surface finish
- _ Enterprise-Grade Cloud Software with ISO 27001 certification
- _ Platform built to scale with adaptive manufacturing and part validation
- _ Workforce enablement through Markforged University

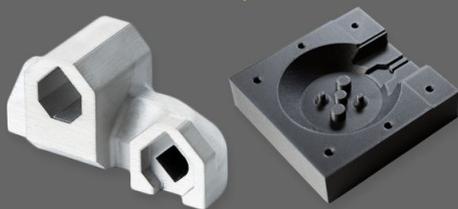


The Digital Forge

Bringing the power of agile software engineering to the world of industrial manufacturing



Enterprise Software



Industrial Materials



Industrial 3D Printers



Reliable and robust hardware



X7



METAL X



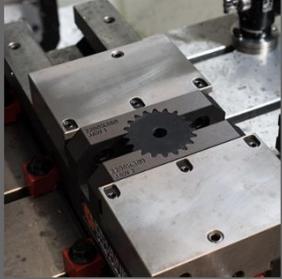
WASH-1



SINTER-2



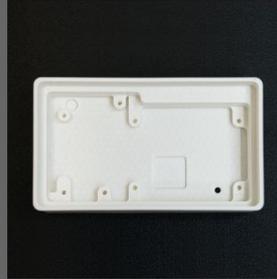
Composites



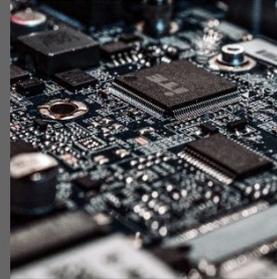
Onyx



Onyx FR



Nylon White



Onyx ESD



Continuous Fibers

Metals



17-4PH Stainless Steel



Inconel 625



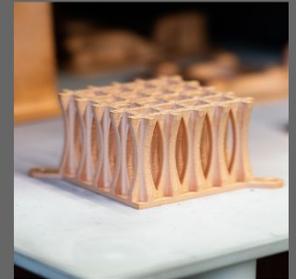
H13 Tool Steel



D2 Tool Steel



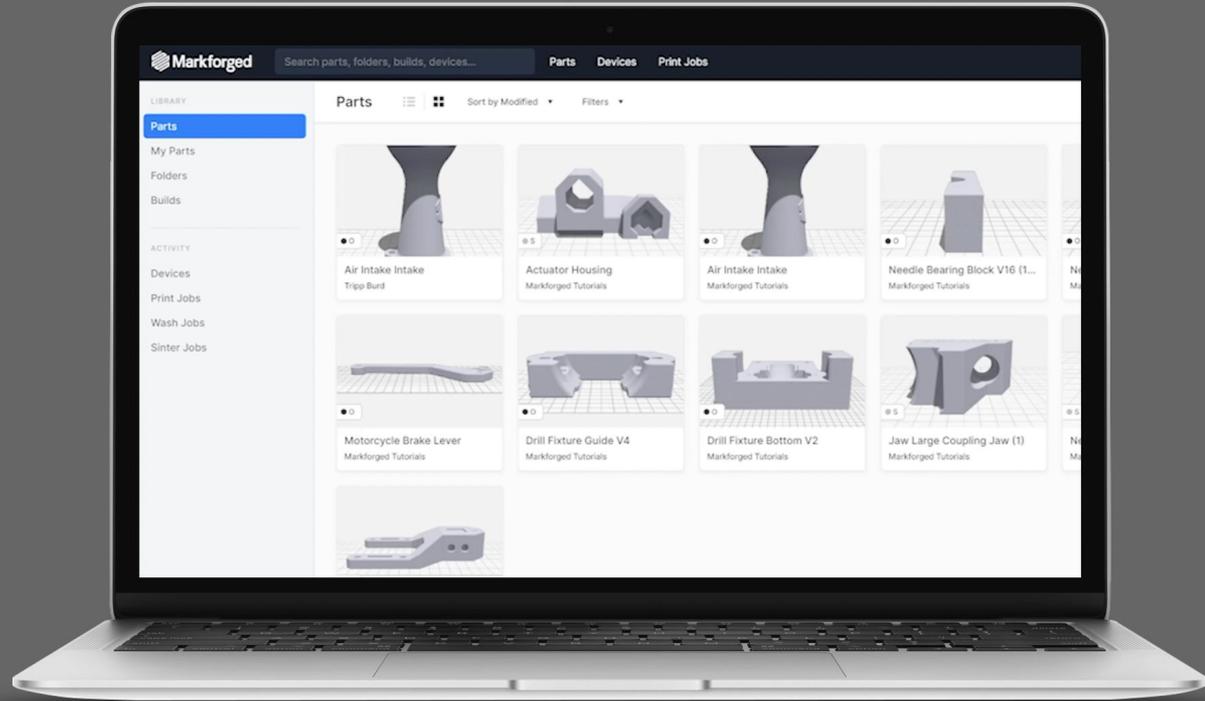
A2 Tool Steel



Copper

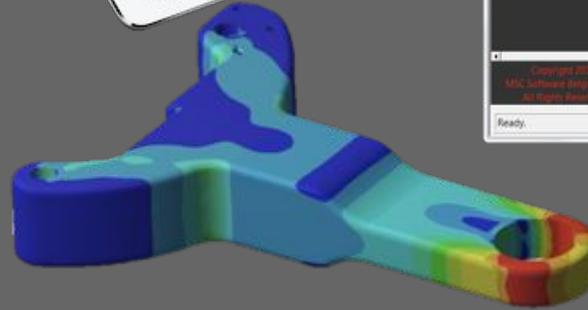
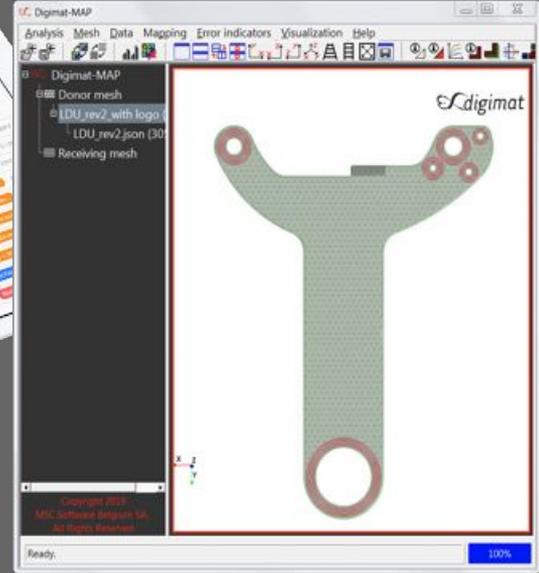


Turnkey software delivers a seamless experience

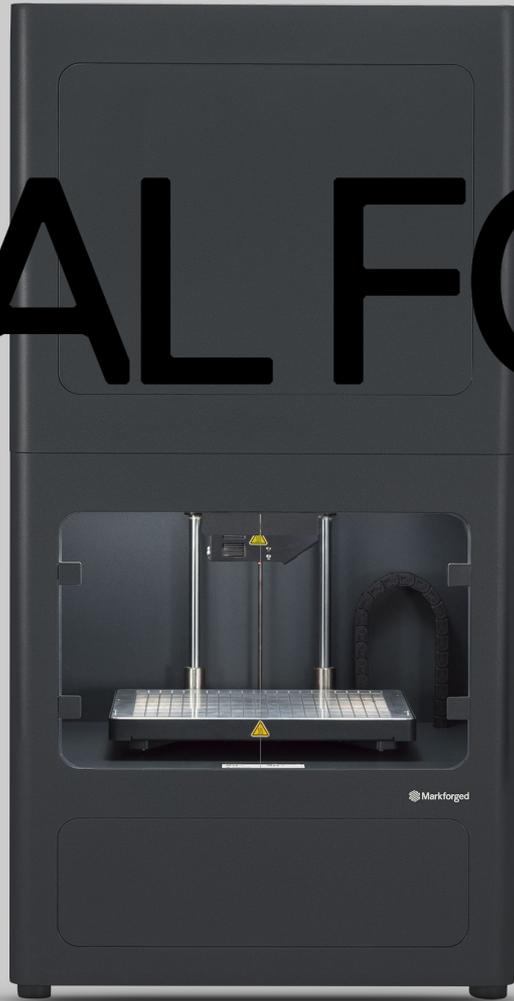


Integrated with the modern factory

Fleet management and monitoring
ISO27001 security
Material characterization
FEA and simulation



DIGITAL FORGE



Built for today.

Designed for
tomorrow.

 Markforged

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