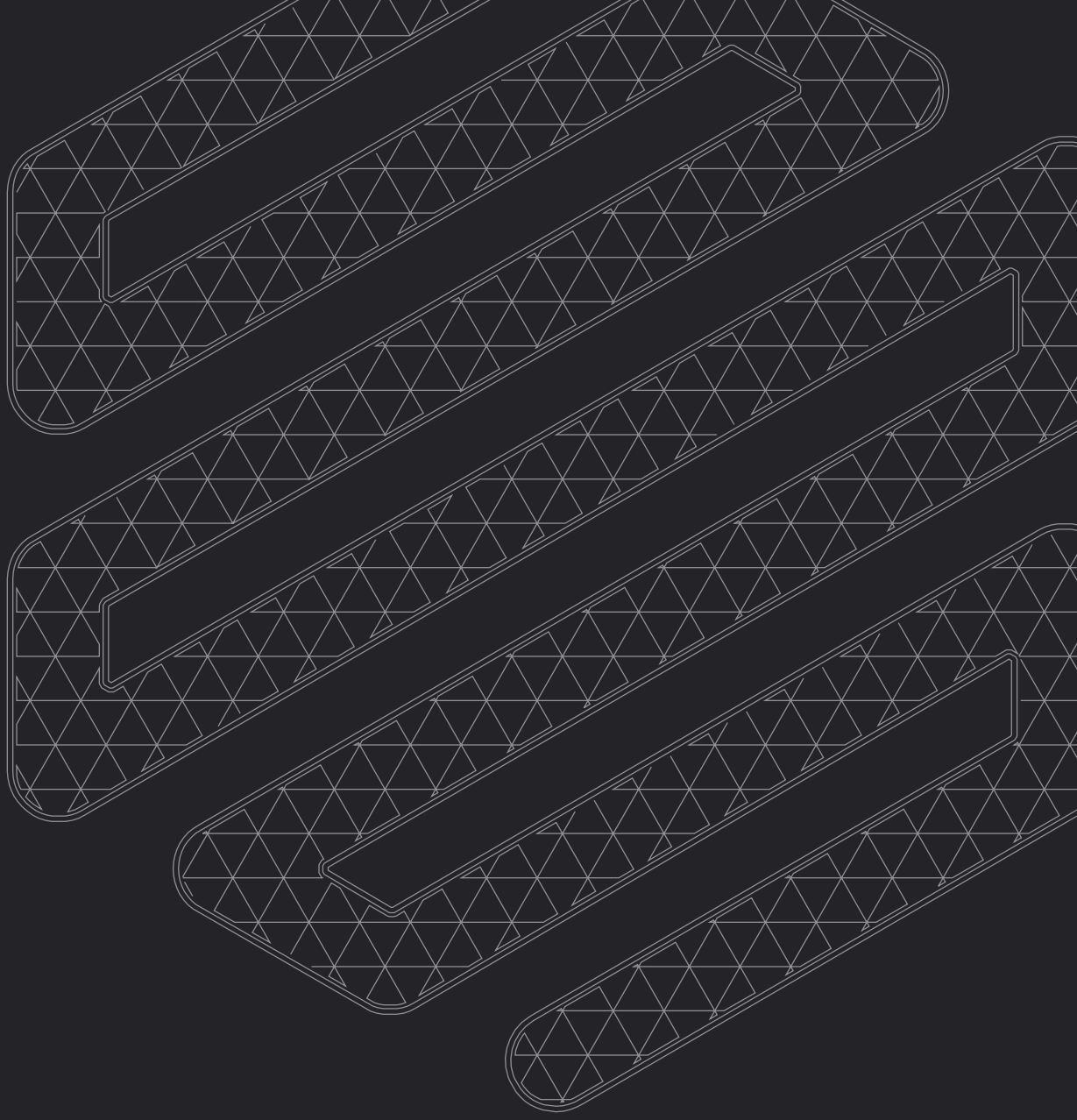


What Problems Can You Solve with Metal Additive Manufacturing?

Markforged

Mark3D
Print Stronger

Why Choose Metal Additive Manufacturing?

With all of the hype around 3D printing, it can be easy to get lost in fascinating, intricate metal parts made with additive manufacturing. These parts, while impressive, are probably dissimilar from many of the parts you currently produce or use. So why invest in metal additive manufacturing?

The importance of metal additive manufacturing is not about what wild geometries you can dream up. It comes from what manufacturing challenges the technology is well-suited to tackle. Companies that successfully adopt additive manufacturing apply its advantages to the challenges that they uniquely face. In this paper we discuss three benefits of metal additive manufacturing and three problems the technology is apt to solve.

Benefits of Metal Additive Manufacturing

Geometric Freedom

Additive manufacturing turns classic machining design methodology on its head. Large, bulky geometries are the norm in traditional design practices — small complex features add time and cost as the number of operations and setups increases. Additive manufacturing builds parts up instead of cutting them down, so it is more efficient to only use material exactly where it needs to be. These advantages manifest especially in curved, natural features that would require heavy cutting with a CNC machine, so working with metal 3D printers enables geometric freedom.

Full Automation

A significant portion of a machine operators' time is put to work generating toolpaths and dialing in G-code depending on the tools and materials being used. Metal 3D printers eliminate much of this setup time by automatically generating toolpaths based on configurable settings, only requiring a few inputs like part orientation and material. After that, the printer can handle the rest.

Whether you're printing in steel, titanium, or inconel, the machine deposits material in almost exactly the same way. No specialized manufacturing knowledge or CAM workflows are necessary to kick off a print, and a wide range of materials are available. Since the machines operate without supervision, you can maximize machine uptime by letting the printer run during non-working hours.

Minimal Tooling or Setup

Metal additive manufacturing reduces money spent on non-revenue-generating parts because no effort is put toward tooling or workholding to support creating the part. No custom tooling or fixturing setups are needed to run a metal 3D printer, regardless of the parts you send it. This reduces overhead and startup costs associated with manufacturing, and produces low-volume parts more quickly and affordably as a result.

What Challenges Does Additive Manufacturing Solve?

So, how do you know which parts to print, and how they can impact you and your business's bottom line? The first step is identifying your manufacturing pain points. Where do you face challenges that impact yield, and what is the cost of these inefficiencies? Metal additive manufacturing is worth the investment if the parts increase or maintain performance with lower effort, cost, or time, overall increasing your bottom line.

In the following pages, we present three use cases applicable to many industries that can be addressed with additive manufacturing, including simplified assemblies, optimized geometries, and digital inventory and legacy parts. These three use cases can take form in many different ways, but all stem from the benefits that metal additive manufacturing brings to the table.

Simplified Assemblies

Optimized Geometries

Digital Inventory and Legacy Parts

Simplified Assemblies

Complex parts manufactured through traditional methods are often broken up into separate sections to improve their manufacturability. While this simplifies the production of these components, it complicates the assembly process, leading to higher product assembly time, increased inventory needs, and higher risk of component failure.

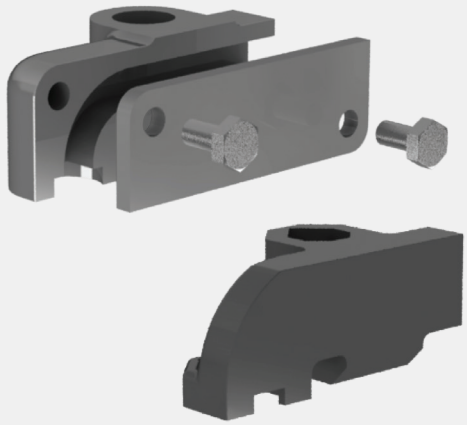
With more geometric freedom and minimal tooling and setup, metal additive manufacturing encourages consolidating multipart assemblies into single parts for printing. This reduces overall weight, minimizes part count, and reduces the number of manufacturing and assembly steps required to make the part.

What to look for:

Are there sub-assemblies in your design that were split into multiple parts for manufacturing simplicity? Look for designs requiring features like internal channels, slots, or complex surfaces that were broken into subcomponents.

Customer Spotlight: Stanley Black & Decker

The STANLEY PD 45 is a high efficiency hydraulic post hole driver. To actuate the driver, the device uses a group of ball bearings within a housing to transfer the trigger pull force into the actuator. The original housing consisted of four parts — a cast and machined main housing, a laser cut cover plate, and two bolts to fasten the housing assembly together. Stanley Infrastructure Innovation engineers reduced this four part assembly down to one, saving 92% on cost and 95% on time.



Optimized Geometries

Metal additive manufacturing opens up a different way to make metal parts. Many of the constraints that limit designs for more traditional manufacturing methods like machining, casting, or extrusion do not apply. Adhering to the limitations of the process means modifying part features to reduce manufacturing time and cost. Optimizing a part for conventional manufacturing, for example, might involve reducing material removal, adding large fillets to internal corners, or restricting part features to one or two faces. This often limits machined parts to simple geometries.

While metal additive manufacturing has its own set of design strategies, they are radically different than more traditional methods. Since the part is built up rather than cut away, additive manufacturing provides the geometric freedom for more organic and complex shapes that might be costly or impossible to fabricate with other methods. You can focus explicitly what your part needs to succeed, and how it can be designed in the most efficient way.

What to look for:

Identify the performance metrics of the equipment you work on. Can processes be sped up or increase yield with better optimized parts? Think about weight savings, conformal profiles, cycle time, and service life.

Part Showcase: Generatively Designed Bracket

This bracket is one of four securing a 20kW, 200A motor for a heavy duty robotics application. The part is performance-optimized for the loading conditions it experiences, made with a generative design CAD program to add material in exactly the right places. By doing so, the bracket's weight was reduced by 75% from its machined counterpart, improving the machine's speed and overall performance.

Digital Inventory and Legacy Parts

Component weardown is an expected consequence of any product, no matter the industry or scale. However, some parts are easier to replace than others. Manufacturing runs create a fixed number of parts, after which spares are hard to come by. When these parts break on machines in the field, there are limited options for both manufacturers and field technicians. The manufacturer may have spare inventory that can be shipped to the site of the breakdown, which poses challenges — especially in remote or international locations. The technician can contact local manufacturers for a very small production run, but rapid manufacturing services in low volumes comes with steep price tags. Lastly, the technician could attempt to repair the part on their own, which will cause more failures down the line.

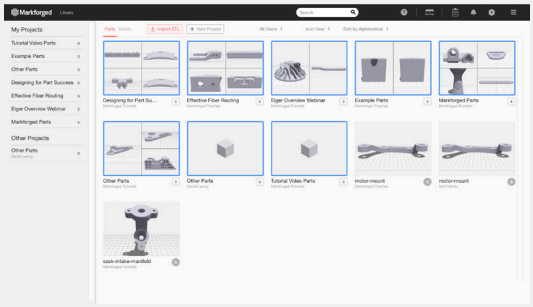
With full automation and minimal tooling and setup, having a metal 3D printer on-site eliminates these maintenance roadblocks with powerful fleet management software. Digital copies of replacement or legacy parts, complete with their printer settings, can be stored and sent to metal 3D printers located both on- and off-site. This means that a replacement part can be made wherever there is a printer.

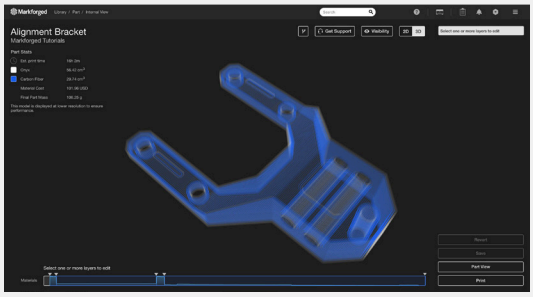
What to look for:

What are the most common replacement parts or wear items that break during use and in the field? What is your process for handling replacement requests? How much does creating small production runs of those replacement parts cost?

Product Highlight: Markforged Eiger Software

Eiger is the business-level printer management software that runs Markforged machines. Each organization has their own secure instance of Eiger, within which they can set up parts for printing, share and review parts with teammates, and kick them off on any printer connected to the organization. A part designed by an engineer at headquarters can be sent to a printer in the field, so a technician can replace and repair equipment with minimal downtime.

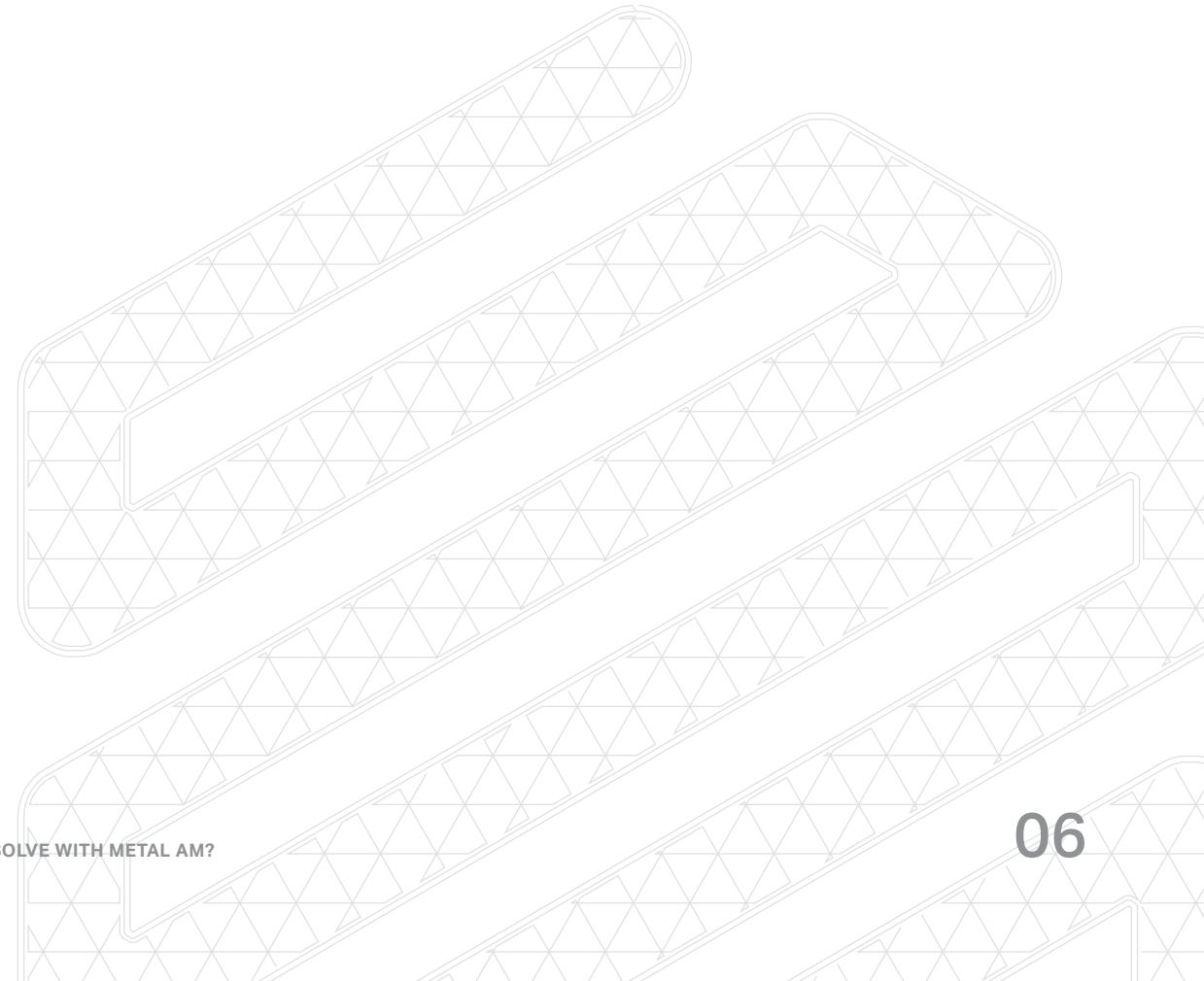




The Metal X

The Metal X system is a safe and affordable metal additive manufacturing solution that is up to 90% less expensive than alternative metal additive manufacturing technologies, and 95% faster and cheaper than traditional fabrication techniques like machining or casting. By printing metal powder bound in a plastic matrix, Markforged has eliminated the safety risks associated with traditional metal 3D printing while enabling new features like closed-cell infill for reduced part weight and cost. The Metal X comes equipped with powerful cloud-based software that manages printers, active jobs, materials, and error detection to make it the simplest way to manufacture metal parts.

Visit **mark3d.com/en/3d-printers/metal-x/** to learn more about how the Metal X can support your business today.



We look forward to you!

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