

Why Additive, Why Now?



3D Printing in 2022

Additive manufacturing (AM) carries unique benefits compared to traditional manufacturing.

Production of everything from prototypes to end-use parts is faster, cheaper, easier to use, and more accessible than subtractive manufacturing methods — which are more complicated and expensive to operate. Investing in additive manufacturing can greatly improve efficiency and agility while minimizing supply chain risk, while its automated processes reduce the need for specialized labor. 3D printing is also efficient: you build only what you need to, and nothing more.

Additive manufacturing has seen widespread use due to these benefits. 3D printing technologies have continued to move forward and several key advancements have been made in recent years. Today, AM solutions are more reliable and effective than ever before. They have a wider range of capabilities and potential applications, and can print parts that address specialized needs.

So, what are these improvements, how do they translate into concrete benefits for manufacturers, and why is now the time for businesses to invest in additive manufacturing? Read this white paper to learn directly from our resident engineers and technical experts here at Markforged.

Additive Today: What's Changed?

Additive manufacturing is still a relatively new technology. The first commercially available 3D printers were introduced in the late 1980s. However, due to its potential to be the most effective solution for many common manufacturing pain points, maturation has occurred at an incredibly fast rate. The last five years have produced some of the largest advancements, as vendors have competed to build solutions that meet the needs of specialized industries.



Power and Reliability — To meet manufacturers' needs for scaled production, industrial 3D printers evolved with significantly improved print speeds, reliability, maximum part sizes, and part quality. Even desktop-sized 3D printers can now be trusted to produce consistent, high-quality results in key manufacturing roles.

User-friendliness — Historically, industrial-scale 3D printing systems required dedicated operators with extensive user training. The level of training required was akin to CNC mills. Development of user-friendly 3D printing software has since streamlined and automated many previous points of complication into a far more simple process.

Operating newer 3D printing platforms has a minimal learning curve, and does not require additive manufacturing expertise. Users can even automate quality inspection of parts during the 3D printing process itself, to verify that the parts will be immediately usable. Rather than breaking up printing and part inspection into two separate stages, parts can be inspected as they are fabricated. Manufacturers pushing the boundary of additive today with Markforged



Innovative Materials — 3D printing applications expanded in many new directions. The range of available materials has also grown to fit new needs. Materials now fit specialized purposes, such as aerospace-grade composites that are stronger than machined aluminum but with just a fraction of the weight. Parts can be printed with high heat resistance, chemical resistance, and fortified with continuous fiber reinforcement (CFR) technology to add extra strength anywhere within the part.



Metal Made Accessible — The introduction of metal fused filament fabrication (FFF) technology means 3D printing metal parts is now faster, safer, and more cost-effective than ever. Metal FFF printers offer a wide range of material availability — such as stainless steel, tool steels, Inconel, and copper — and can be operated with minimal PPE and safety precautions.

Industry 4.0 Connectivity — 3D printing software integrations allows users to initiate part production through requests in core factory systems — such as a manufacturing execution system (MES), Enterprise resource planning (ERP) or enterprise asset management (EAM) system — or, by scanning the barcode of a physical part that needs to be duplicated.

Cloud-based connectivity between each user and set of printers also allows for distributed manufacturing operations. Users can initiate prints across 3D printers in different geographic locations. This ensures the right part is available both where and when it is needed.





Tackling Today's Supply Chain Challenges

Supply chain shortages pose the most critical threat to manufacturing operations today. Recent supply chain shortages are taking place on a global scale, and companies have been experiencing unprecedented levels of difficulty procuring the parts they need. Without the ability to quickly fabricate the needed parts in-house, manufacturing operations can easily stall for however long it takes for the part to be built, shipped, transported, and received. This often takes months.

Access to on-site 3D printers allows companies to take full control of their supply chains. Individual printers can be placed across different geographic locations; parts stored in a cloud-based digital inventory can then be sent to be printed at any 3D printer within the network. The right parts can be quickly printed at the precise locations where they are needed, when they are needed, with far shorter lead times compared to traditional manufacturing.

For parts that must be machined, using an AM system for rapid prototyping will help engineers ensure that when the machined part is finally received months later, it will work as expected.







The Immediate Impact

Implementing an additive manufacturing solution leads to diverse business benefits. Beyond the multifaceted improvements it provides to manufacturing operations, adoption of AM is representative of a cultural shift that puts innovation and individual autonomy first.

Previously, many of these benefits were limited to select companies with less demanding manufacturing needs. Advancements to additive technology, however, have made these immediate benefits applicable to manufacturers of all scales, across almost every industry.

More Parts Produced In House — When companies outsource a core manufacturing competency to a third party, they establish a dependency for tooling, fixtures, and jigs needed to produce the final product. As a result, manufacturers forfeit control and are subject to higher costs, prolonged timelines, and decreased transparency; while quality issues and other complications require additional time and coordination to address. Producing parts inhouse also allows companies to better protect intellectual property, proprietary innovations, and other trade secrets.

Significant Savings —3D printing is typically far more costeffective than traditional subtractive manufacturing. 3D printing tooling for production can save manufacturers tens of thousands of dollars per month compared to machining. For most manufacturers, additive manufacturing platforms will yield a near-immediate ROI: within months, or even weeks. Design Freedom, Process Flexibility — The processes used to manufacture parts are oftentimes dictated by the limitations of what the traditional manufacturing process supports. For example, when manufacturing a bracket using subtractive techniques, unnecessary constraints are imposed by having to start with sheet metal, while bending or stamping into shape. Designs can be made without these steps and limitations through additive. Military & Defense









Put Parts to use Faster — The time it takes 3D printing to go from art to part is just a fraction of what it takes through subtractive manufacturing processes. The cycle from when the need for a part is recognized — all the way to when it is implemented — can be cut down to just hours or days, compared to months, as long as 3D printers are available.

Increased Speed to Market — Access to in-house AM accelerates design cycles by enabling rapid prototyping. It can produce any part in a fraction of the time it would take to request and receive via traditional manufacturing processes.

Full Supply Chain Control — Use of a 3D printing platform allows them to control their full supply chains from end to end. Manufacturers can reduce dependence on external suppliers and minimize risk in their supply chain operations.

Building a Culture of Innovation — For job-seeking engineers, companies invested in an AM strategy present opportunities to focus on innovation and solve interesting design problems, while automating the arduous tasks and eliminating unnecessary constraints that come with subtractive manufacturing processes.

Engineers with access to in-house 3D printing do not have to worry about time-consuming procurement activities like drafting drawings, submitting purchase orders, and managing the bidding process with multiple vendors. Healthcare & Medical

Medtronic

Gillette

Alcon







Why Now?

Today, 3D printing is a mainstream manufacturing technology for everything from prototyping to production of end-use parts. Leading manufacturers across all industries continue to adopt AM at increasing rates while scaling up use of their 3D printing systems with additional printers, software tools, and new materials. While industry leaders continue to reap the many business benefits associated with 3D printing, organizations without an additive manufacturing strategy will fall behind their more agile, efficient, and innovative competitors.

Markforged has empowered thousands of customers to adopt additive manufacturing strategies. We've learned from working with these organizations that earlier adoption of AM technologies produces superior outcomes. While earlier 3D printing technologies were not always applicable to the full range of industries and uses relying on AM today, these companies had longer to build and refine their additive strategies. They've had more time to integrate AM into their workflows, experiment with different settings, and discover additional applications for additive within their operations. When printers with new capabilities arrive in the future, these organizations are better prepared to make the best use of newer equipment, equipped with the knowledge and experience to increase the scale of their AM operations more smoothly.



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Markforged (NYSE: MKFG) is reimagining how humans build everything by leading a technologydriven transformation of manufacturing with solutions for enterprises and societies throughout the world. The Markforged Digital Forge brings the power and speed of agile software development to industrial manufacturing, combining hardware, software, and materials to solve supply chain problems right at the point-of-need. Engineers, designers, and manufacturing professionals all over the world rely on Markforged metal and composite printers for tooling, fixtures, functional prototyping, and high-value end-use production. Markforged is headquartered in Watertown, MA, where it designs its products with over 350 employees worldwide.

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