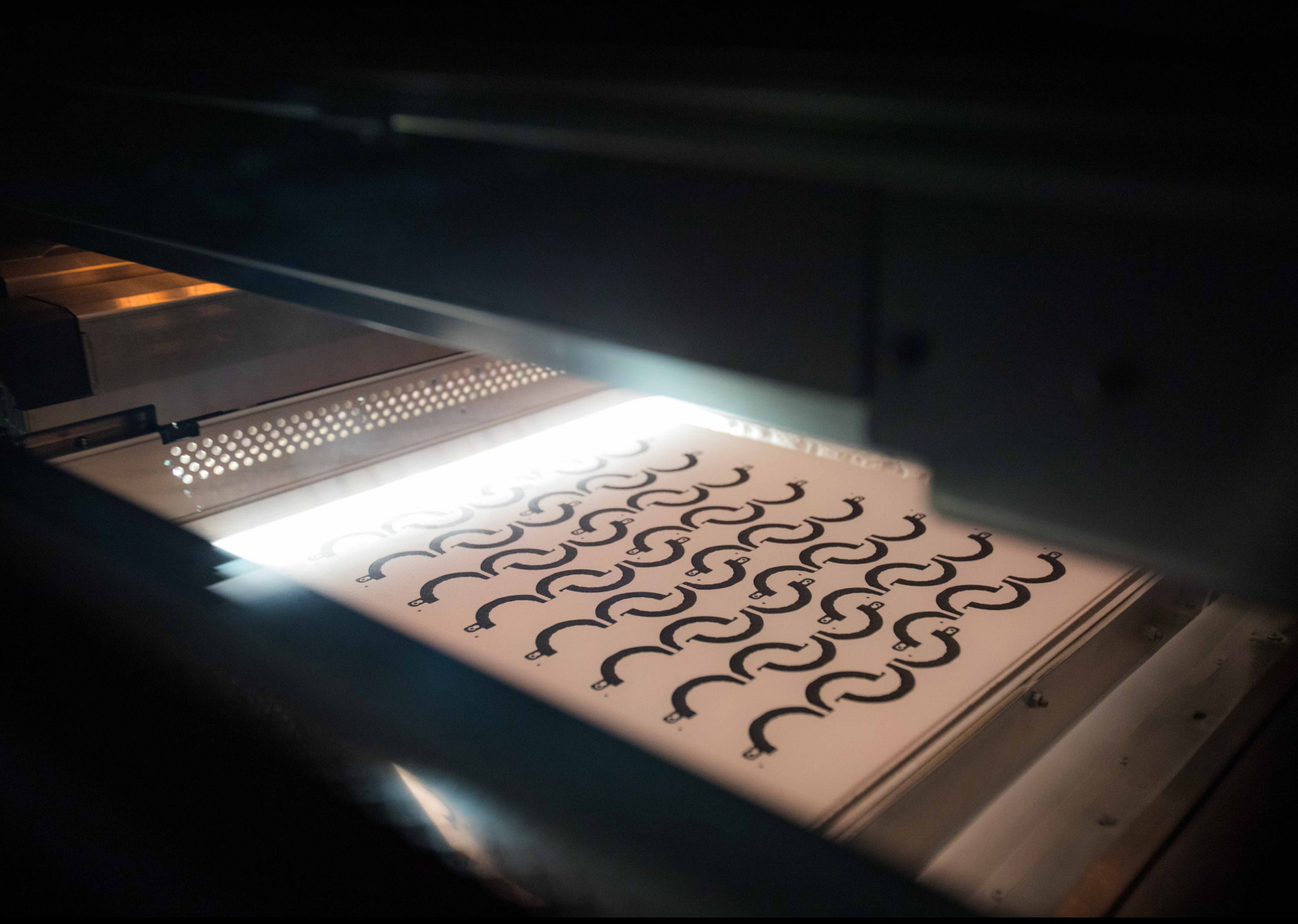

3D Printing Trend Report 2022

Market changes and technological shifts in the 3D printing market

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Key findings

3D printing has moved past its predominant role as a prototyping technology and is evolving into a viable solution for end-use parts and larger-scale production applications.

$44.5bn

We predict the overall 3D printing market will grow by 24% to reach $44.5 billion by 2026

$9.9bn

3D printing hardware is expected to peak at this market size within the decade [22]

24%

of respondents to our 2022 survey still saw cost as the main hurdle to using 3D printing

49%

printed 10+ parts in their production runs, compared to 36% in 2021

44%

believe the top development in 2022 will be new materials and composites

68%

of engineering businesses surveyed used 3D printing more in 2021 than in 2020

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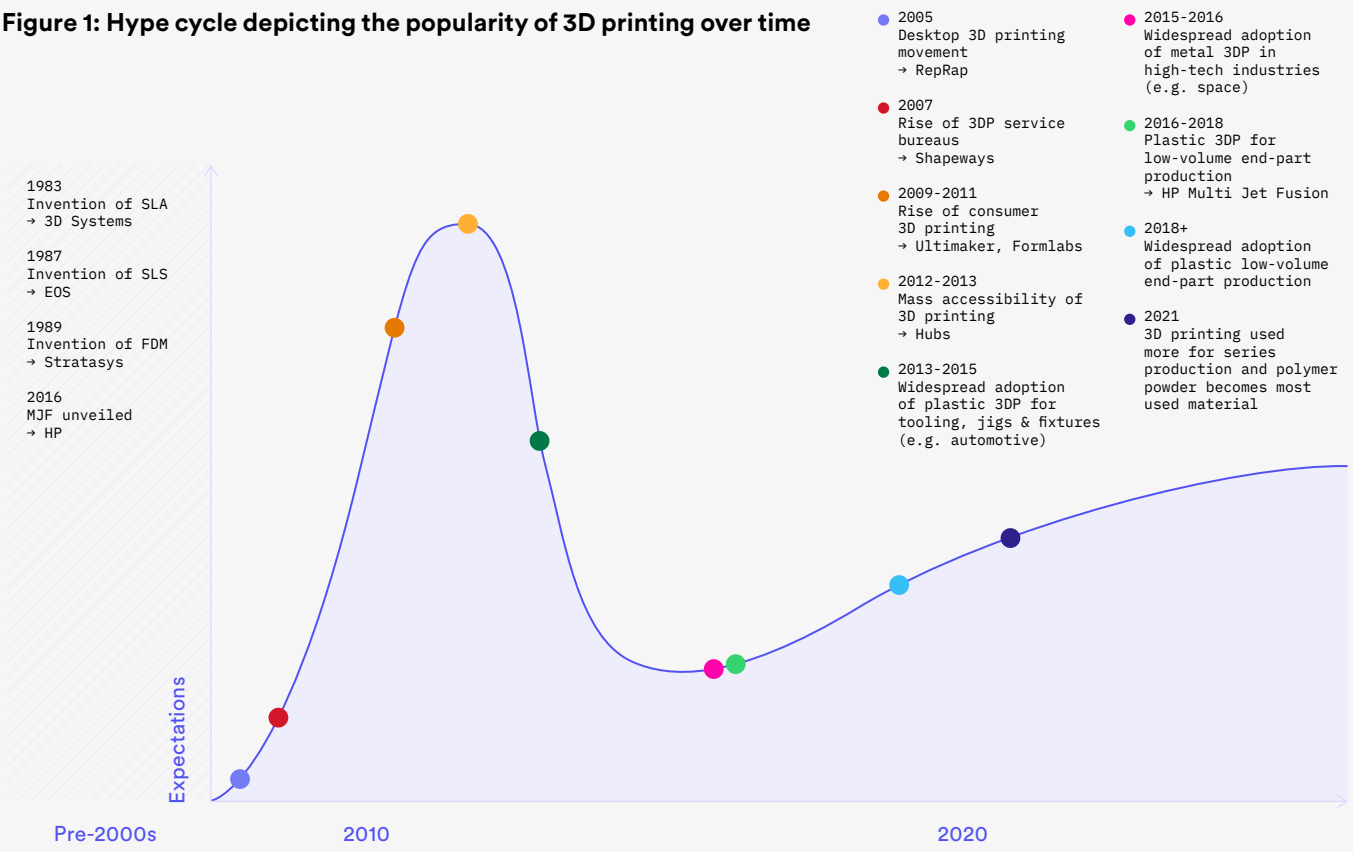
Introduction

How 3D printing evolved in 2021 and where it's going in 2022

Figure 1: Hype cycle depicting the popularity of 3D printing over time



Source: Hubs

3D printing technology and its place in manufacturing have evolved significantly since its invention in the early 1980s. In recent years, 3D printing has shifted from consumer markets, moving past household hype to establish itself as a more widely applied industrial manufacturing process. Industry developments in 2021 and 2022 are positioning the technology to surpass its role in functional prototyping and become a viable solution for end-use parts and serial production.

This report will investigate the state of the market in 2021 while also exploring the trends shaping the industry in 2022 and the coming years, including the impact of the COVID-19 pandemic and innovations in material composites.

How we created this report

We collected market trend data from three main sources to produce this report:

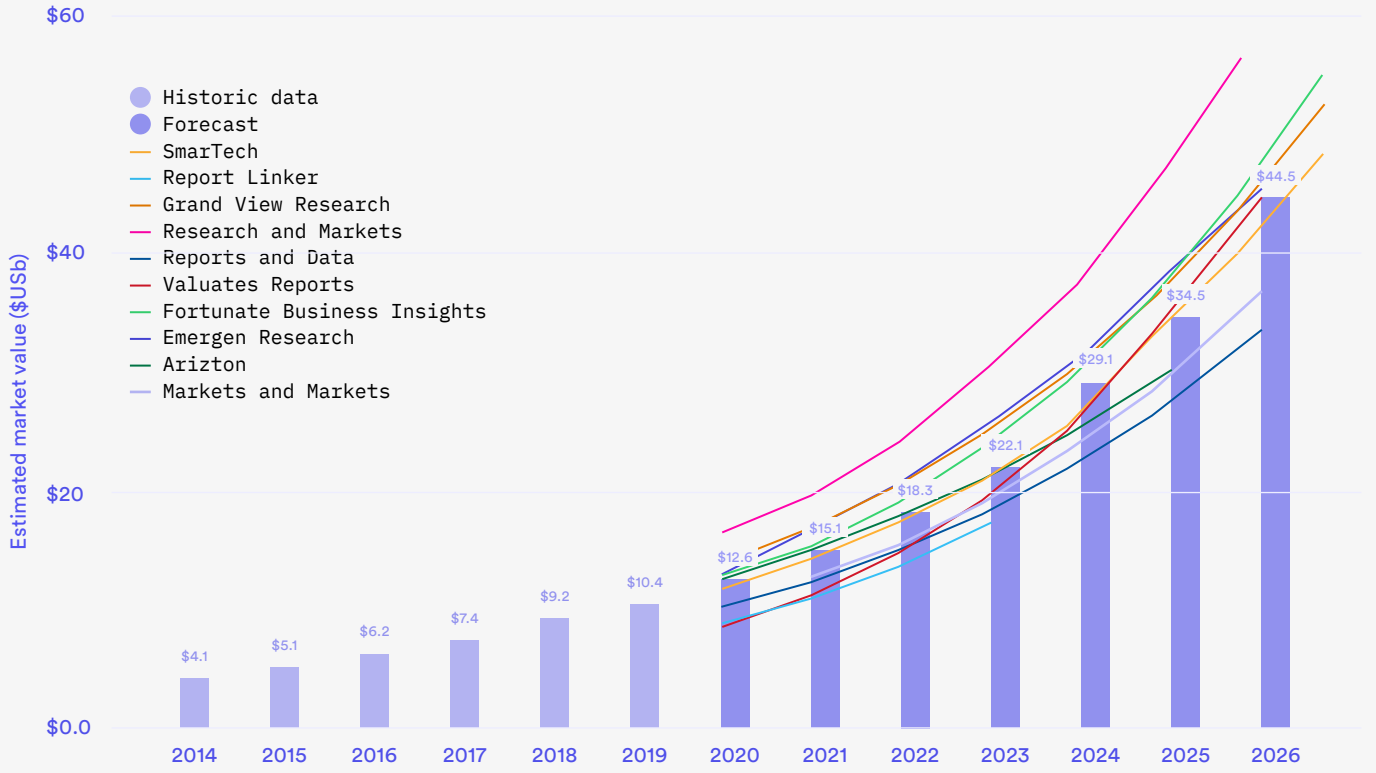
- A survey sent to our global engineering community
- A systematic review of 3D printing news and related media
- A comparative review of reports by recognized analysts and consultants

The survey gives us insight from several hundred engineers, designers, manufacturers and other leaders within the industry. The review of news and media provides an overview of the direction of the industry, and market analysis outlines financial forces that continue to drive the growth of 3D printing technologies and their applications.

By comparing the results of the survey and other sources - all released and collected in 2021 and 2022 - we've come to a more holistic picture of the current state and direction of the 3D printing market.

3D printing market growth

Figure 2: 3D printing market forecast



Footnote:
* The historic market size was calculated by averaging market size reports listed in the graph.
** The market growth forecast is based on research predictions of market analysts and research companies, using the designated CAGR.
*** Links to all sources can be found under the References section of this report.

Based on a CAGR of 24 percent, the overall market in 2026 will reach roughly $44.5 billion

The graph above summarizes data reported by several reputable market analyst firms that evaluated the 3D printing market segment in 2021, including revenue from 3D printing systems, software, materials and services, but excluding internal corporate investments in 3D printing technologies. It was constructed based on publicly available information and it provides the best estimate of the current size and future potential of the global 3D printing market.

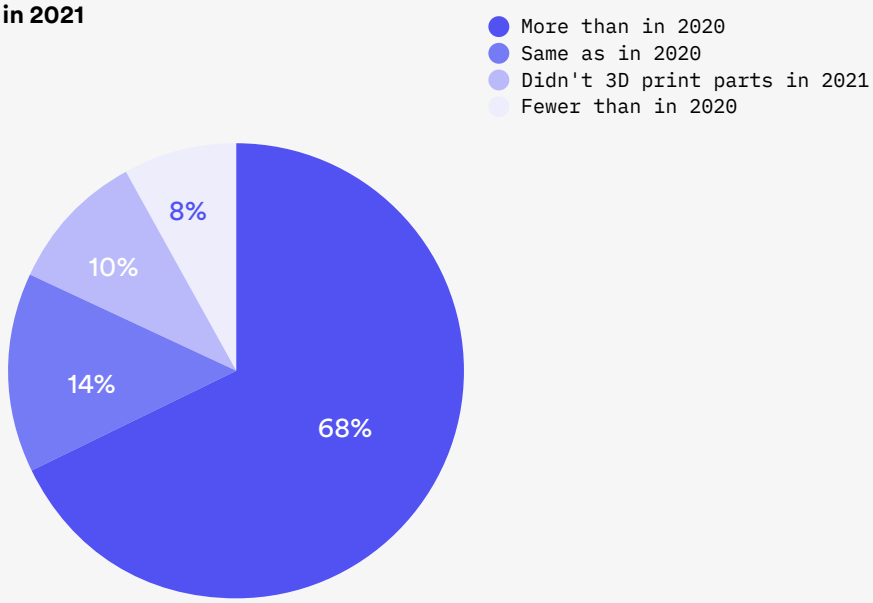
The 2021 market size was estimated at $15.1 billion on average, ranging from $10.8 billion to $19.5 billion. These widely varying predictions are largely tied to the data available when each report was compiled and released, with the rolling global lockdowns due to the pandemic also affecting the data.

The $15.1 billion market size represents a 19.8% increase over 2020. Our 2021 report predicted it would be $15 billion with a 19% growth rate, so we were very close to the mark. Based on the median value of market forecasts of these leading industry reports, we estimate the market will grow by 21% this year to hit $18.3 billion by the end of 2022.

The compound annual growth rate (CAGR) for the five-year period before the COVID-19 outbreak (2014-2019) was 21%, so we are closing in on pre-pandemic industry growth.

Our current forecasts show a CAGR of 24% over the next five years, which is exactly in line with our 2020 report — and well above our 2021 report that predicted a CAGR of 19% — indicating market recovery and increased confidence in industry growth.

Figure 3: Quantity of parts 3D printed in 2021

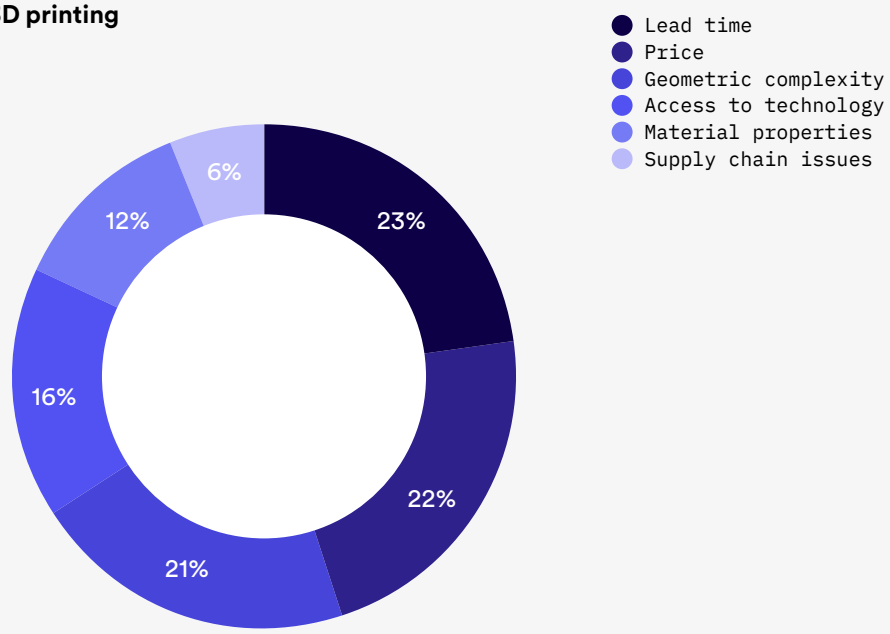


Q: How many 3D printed parts did you source/produce in 2021?
Source: Hubs survey, conducted February 2022, n=372

Our survey also reflects market growth, with 68% of respondents saying they 3D printed more parts in 2021 than in the previous year.

There are also fewer barriers to 3D printing. Our survey shows that only 22% of engineering businesses find the price of 3D printing to be an obstacle, down from 38% last year. In fact, the price point is one of the main driving factors for many engineers to choose 3D printing, along with faster lead times and improved geometric complexity.

Figure 4: Key factors for choosing 3D printing



Q: What have been the key deciding factors for choosing to 3D print parts?
Source: Hubs survey, conducted February 2022, n=372

Polymer and metal 3D printing trends

The pandemic hit the metal and polymer 3D printing markets harder than the industry overall, according to a report by AM POWER. The research shows that in 2019, the metal 3D printing market was valued at around $2.23 billion with an expected annual growth rate of 27.9 percent. In 2020, the market was virtually stagnant, with a value of roughly $2.24 billion.

In 2021, the global metal and polymer 3D printing markets grew by a combined 16.2%, which is a step in the right direction but lags behind our estimated industry average of 19 percent.

Recent data, collected by SmarTech in Q3 of 2021, shows an uptick of momentum for the metal 3D printing market, with 18% growth year-over-year. Polymer 3D printing was trailing a bit behind with 12% growth for the same period.

These numbers indicate that while growth has been slower for metals and polymers compared to pre-pandemic expectations, these markets are bouncing back.

3D printer market update

On the hardware side, market intelligence firm CONTEXT reports that 2021 saw a notable increase in industrial 3D printer shipments. There was a 39% increase in the first three quarters of 2021 compared to the same period in 2020. Despite this growth, shipment numbers were still 6% below the first three quarters of 2019.[03] High-end 3D printer shipments also increased compared to 2020, but demand was greater than supply in this segment. Consumer 3D printer sales have dipped since the early pandemic peak, but are still higher than they were pre-pandemic. These growth levels suggest an upwards trend for desktop machine sales.

3D printing during COVID-19

3D printing came to the forefront as a viable solution to new and persisting challenges.

The COVID-19 pandemic highlighted 3D printing's unique capacity to quickly adapt to production and supply chain needs. 3D printing came to the forefront as a viable solution to new and persisting challenges, as parts and products can be manufactured locally and on-demand.

To combat shortages and supply chain issues that arose during the pandemic, manufacturers and makers used 3D printing to rapidly produce protective equipment (PPE) and medical devices, such as face shields and ventilator valve replacement parts. Manufacturers also began 3D printing nasal swabs for detecting COVID-19, which helped to demonstrate mass-production capabilities.

While a big help in the early days of the pandemic, this use of 3D printing did not last long. Traditional PPE suppliers eventually caught up with demand as supply chains were partially reestablished. Now, in the third year of the pandemic, 3D printing has fewer immediate uses related to COVID-19, but more people now recognize the technology's agility and production potential. For instance, in April 2020, Google searches for the topic of 3D printing hit an all-time high. [09]

3D printing and Industry 4.0

We've observed that businesses that adopted Industry 4.0—an industrial revolution defined by automation, digitization and smart data—before COVID-19 fared better than those holding on to legacy processes. In a survey by McKinsey & Company, 65% of respondents reported that they saw Industry 4.0 as more valuable since the onset of the pandemic, as it provides greater flexibility and automation.[10]

As a digital manufacturing process and part of a broader digital transformation strategy key to Industry 4.0, 3D printing can make production chains more resilient in the face of global crises, like pandemics and climate emergencies.

3D printing in the age of the 1.5°C pathway

One of the greatest sustainability opportunities associated with 3D printing is design freedom.

Across the world, government bodies and private enterprises are racing—or in some cases crawling—to play their part in supporting the Paris Agreement pathway of limiting warming to 1.5 degrees Celsius by 2050.[11] 3D printing has the potential to enhance the sustainability of manufacturing, supporting this broader environmental goal. However, the industry has some catching up to do in terms of transforming potential into consistent action.

More than 90% of people responding to our survey indicated that the Paris Agreement, COP26 or other initiatives had a very small impact on their operations. This lines up with Protolabs' Sustainability Report 2022 which showed that while 88% of companies surveyed have made changes to product design and sustainability plans over the last two years, "there is a disconnect between those who own the sustainability strategy and those responsible for the results." [23] This indicates that companies are moving toward operational and supply chain sustainability in theory, but aren't consistently following through with implementing proposed changes. In our view, there is plentiful untapped potential for 3D printing to support climate action.

As a digital manufacturing process, 3D printing is built for on-demand production. This means that the technology is not bound by the same economies of scale as traditional manufacturing. Parts can be cost-efficiently manufactured on a made-to-order basis, reducing the amount of raw material consumed as well as minimizing inventory and storage requirements. Similarly, manufacturers can take advantage of distributed manufacturing, sending digital files to 3D printing systems for more localized production.

One of the greatest sustainability opportunities associated with 3D printing is design freedom. Intelligent design practices, enabled by generative design and topology optimization software, allow for the production of more efficient parts when used in combination with 3D printing. Engineers can also be strategic in their designs to minimize the use of polymer and metal support structures and reduce the need for support materials. [12]

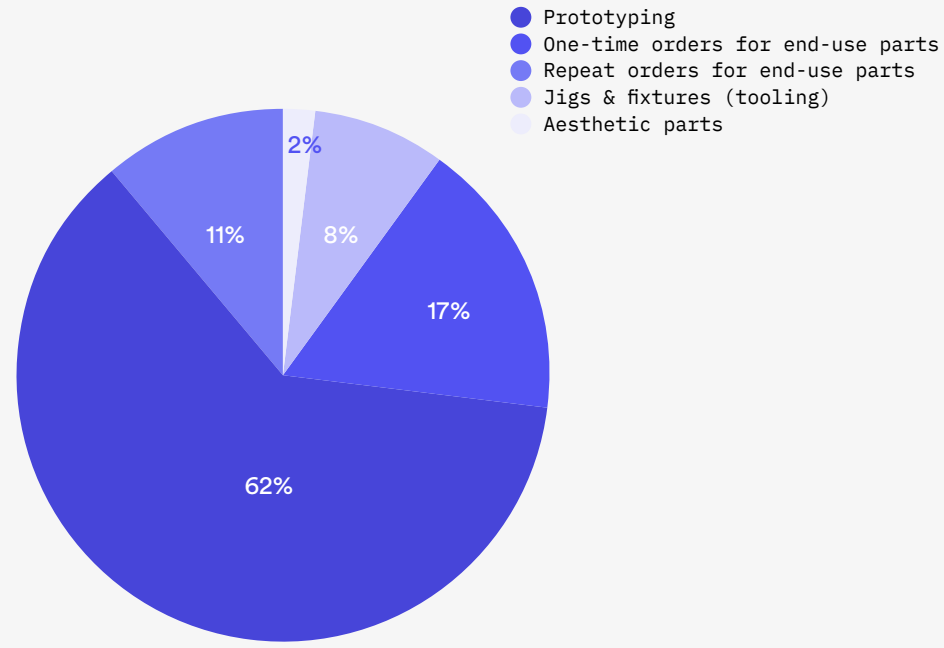
The development of increasingly sustainable materials, including plant-based and recyclable polymers, will also help to push efforts on the sustainability front. According to Protolabs, 41% of companies surveyed listed materials management as their top sustainability concern.

The more materials advance and improve, the more potential they have to enhance existing use cases and open up new applications for 3D printing, which could drive adoption and entry into new markets.

Going beyond prototyping

3D printing for production

Figure 5: 3D printing applications



Q: For which applications do you use 3D printing most?
Source: Hubs survey, conducted February 2022, n=372

As 3D printing continues to mature, its position in manufacturing is expanding and solidifying, and a few key dynamics are becoming clearer. Moving forward, 3D printing will:

- Continue to be used as a prototyping process to accelerate product development.
- Play a supportive role in combination with other manufacturing processes through the production of tools, jigs and fixtures.
- Become more viable for end-use parts and serial production.

Many of the industries that have embraced 3D printing, including healthcare, aerospace, automotive, energy, motorsports and sporting goods, are today using the technology to produce functional end-use parts. In fact, while the adoption of 3D printing as a prototyping technology has remained fairly consistent in the past few years, some sources point to an increase in end-use 3D printing adoption.

A 2021 study on the state of 3D printing by Jabil reported that in 2019, 52% of users were using 3D printing for production, while in 2020 the number jumped to 62 percent.[13] Our ongoing surveys follow this trend, with 29% of this year's respondents using 3D printing for aesthetic or end-use parts. This is up from 21% in 2020.

Using 3D printing for production enables users to take advantage of the technology's design freedom and production agility for final products. Looking at current trends, there are three prevailing production applications for 3D printing: low-volume production, mass customization and serial production.

Low-volume production

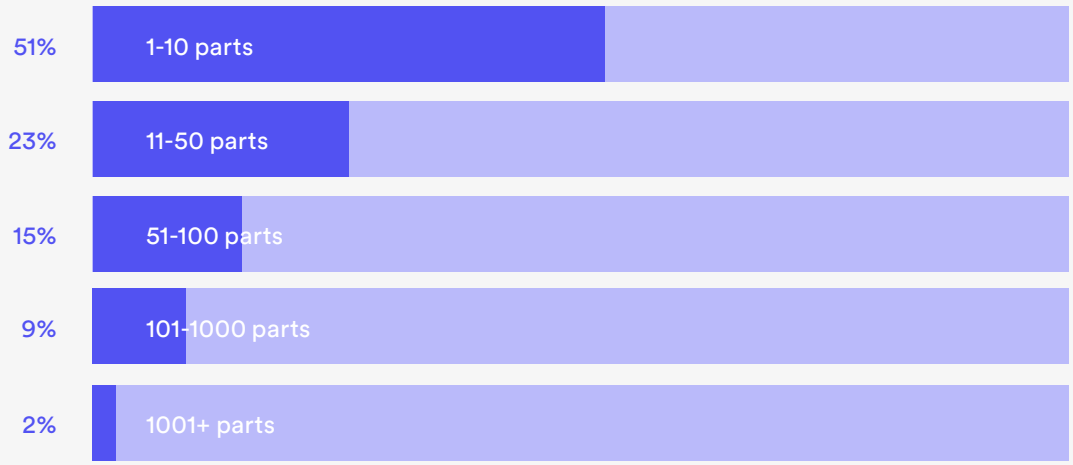
In the case of low-volume production (100-1000 parts per run), we can turn to the motorsport industry for some key examples. In this industry, especially in Formula 1, there is a need to produce highly advanced components in small production runs to achieve a competitive edge. 3D printing has been vital for motorsport engineers, enabling the individual or low-volume production of complex structures that are both lightweight and robust. End-use parts in motorsports today include exterior body parts, powertrain and engine components, fluid management parts, as well as many others.[14]

The same needs are present in the aviation and aerospace industries, where well-engineered, more lightweight components are paving the way for greater fuel efficiency. GE Aerospace demonstrates this with the GE9X engine, which integrates 300 end-use 3D printed components, including a nozzle designed for more efficient fuel consumption. The engine, recognized as the most powerful jet engine in the world, is now FAA certified.[15]

Smaller aviation startups are also turning to 3D printing and digital manufacturing platforms to produce commercial-grade parts in prototyping quantities. Ampyx Power, an airborne wind energy company based in The Netherlands, used Hubs to print parts for two autonomous aircraft, designed to test the efficacy of turbine-less wind power generation. These parts help to form vital components of the aircraft that manage autonomous takeoff and landing, which means they are under significant mechanical strain.[24]

The move toward low-volume production spans many sectors. In our 2022 survey, 49% of respondents used 3D printing for production runs of more than 10 parts, which is up from 36% in 2021.

Figure 6: Size of 3D printing production runs



Q: In general, how big are your production runs of 3D printed parts in 2021?
Source: Hubs survey, conducted February 2022, n=372

Mass customization

3D printing is also unlocking mass customization options. The dental industry, for example, is increasingly using 3D printing to produce patient-specific implants and dental devices like dentures. On the flipside of physiology, 3D printing is also now commonly used to create customized insoles and orthotics. These are examples of direct production, but 3D printing is also unlocking mass customization through indirect production with the creation of low-cost patterns for molds. This approach is now quite common in the jewelry and dental industries.

For example, teledentistry company Smile Direct Club uses HP Multi Jet Fusion 3D printing to manufacture millions of custom dental aligners for its clients. The company leverages over 60 3D printers to produce tens of thousands of custom aligner molds per day, later used on thermoformed unique aligner sets for straightening teeth.[16]

Formify, a Toronto-based tech startup that creates custom ergonomic computer mice for the gaming industry, presents another interesting use case. The company custom-produces each personalized mouse with high-precision MJF 3D printing, using an algorithm that analyzes a customer's hand shape and joint and bone structure to inform the ergonomic fit. Using MJF, Formify can repeatedly produce completely unique pieces without having to rely on molds. As of early 2022, Formify has used the Hubs platform to manufacture end-use products for celebrity gamers and other alpha customers and is gearing up for an official launch later this year, after showing the efficacy of their mass customization offering.

Formify's MJF printed mouse

Serial production

The 3D printing technology company Carbon is the best-known example of 3D printing for serial production in the polymer sphere. Sportswear giant Adidas is using the company's Digital Light Synthesis (DLS) process to mass-produce Futurecraft 4D midsoles, which integrate a unique lattice geometry.[17] Carbon and manufacturing partner OECHSLER introduced another serial production application in 2021: a lattice-structured bike saddle for performance cycling. Thanks to 3D printing, the partners were able to bring the product from concept to serial production in just 10 months.[18] Ford automotive company also revealed plans to mass produce a metal automotive using ExOne's binder jetting technology within the next few years.[19]

Corroborating these industry findings, digital manufacturing company, Protolabs, which offers serial production opportunities across six different 3D printing technologies, has witnessed a steep rise in the demand for part volumes exceeding quantities of 500. Over the past five years, the demand for production orders beyond 500 3D-printed parts has risen by an impressive 163 percent.[25]

On the Hubs platform, we've seen a 54% increase in the average number of parts ordered in 2021 versus 2020.

Continued advances in 3D printing production workflows will continue to unlock more serial and mass production applications across sectors like consumer goods, industrial manufacturing and automotive.

2022 3D printing trends at a glance

We anticipate a growth in the following 12 trends

1

Adoption of 3D printing across existing markets and a stronger entry into newer markets.

2

Automation across the 3D printing workflow, with an emphasis on post-processing and cobot use.

3

More robust supply chains and localized, on-demand production.

4

High-performance 3D printing materials development and qualification, such as refractory metals, ceramics, high-temperature polymers and composites.

5

Market maturation and consolidation with inter-industry partnerships, mergers and acquisitions.

6

Demand for large-format systems, notably in metal 3D printing.

7

Strategic use of 3D printing, intelligent design and improved materials to make manufacturing more sustainable.

8

End-use production and serial production applications of 3D printing.

9

Reliability and repeatability across 3D printing technologies.

10

Industry standardization, including the adoption of the 3mf file format, which stores geometry, color, texture, material data, lattice, support structure and printer configuration information.

11

On-demand, just-in-time (JIT) manufacturing, driven by the internet of things (IoT).

12

Direct communication between inventory systems and manufacturing capacity, linking supply and demand without human intervention.

The future of 3D printing

Trends we are looking forward to and potential barriers

Figure 7: What do you believe will be the top developments in 3D printing in 2022?

Q: What do you believe will be the top developments in 3D printing in 2022?
Source: Hubs survey, conducted February 2022, n = 372

Despite steady advances, 3D printing still has a ways to go before it is broadly recognized as a fully mature, fully scalable industrial manufacturing technology. So the question is, what will it take to get there?

It will come down to a few factors, with automation topping the list. In order for 3D printing technologies to be implemented for scalable industrial production, the end-to-end workflow—from pre-printing to post-processing—must be further automated. Further automating post-processing in particular will make it easier for 3D printing to scale to industrial levels. Additionally, as end-use production applications increase, especially critical components, scalable quality control is an important consideration. This will be achieved through the strategic use of 3D printing process data, simulation software and the implementation of scalable testing solutions.

The availability of advanced materials for 3D printing applications—including polymers, metals, composites and ceramics—is top of mind across the industry. Greater material choice will drive the creation of new applications, and greater consumption of 3D printing materials will ultimately drive their costs down.

The 3D printing industry also further consolidated in 2021. In the past 12 months, there have been a number of notable mergers and acquisitions (M&As) among some of the industry's leading players. Stratasys acquired Origin, Desktop Metal acquired EnvisionTEC (now ETEC) and ExOne, Sandvik's BEAMIT acquired 3T Additive, 3D Systems acquired Allevi and Additive Works and even Hubs joined forces with Protolabs to to become the world's most comprehensive digital manufacturing platform. This demonstrates that the market is restructuring and beginning to consolidate, while continuing to mature.

Overall, we expect to see more signs of growth in 3D printing in 2022 and beyond. Enhanced automation, scalable quality controls, advances in interoperability, reduced material and processing costs and further industry consolidation, among other key factors, will help 3D printing become the robust industrial manufacturing process that befits its massive potential.

"New materials and material composites, lower pricing and mature post-processing options will also make it more viable to integrate 3D printing into production cycles. As the technology keeps developing, it will provide an even more competitive alternative to injection molding for low-volume plastic parts. What's even more exciting is that advanced material composites, combined with the ability to produce highly complex geometries, will open up new manufacturing possibilities that have been impossible to unlock with traditional technologies."

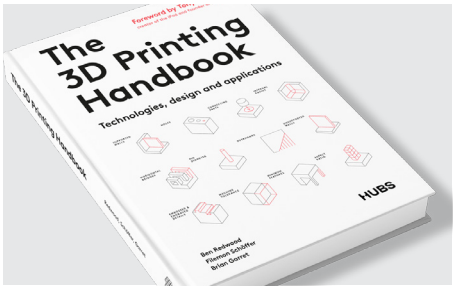
– Filemon Schöffer, co-founder and CCO of Hubs

Further reading

Gain more insights and practical tips within the manufacturing space

3D printing: The complete guide

Read online guide



The 3D printing handbook

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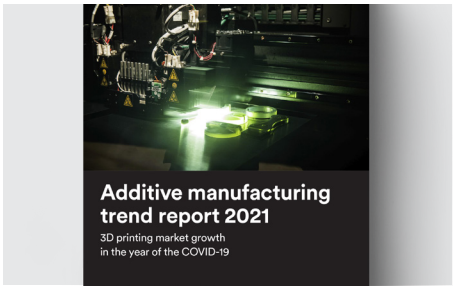

Additive manufacturing trend report 2021

Read report

About this report

Hubs
April 2022

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About Hubs
Hubs, formerly 3D Hubs, is an online manufacturing platform that provides engineers with on-demand access to a global network of manufacturing services. Users can easily upload their design, instantly receive a quote, and start production at the click of a button.

Founded in Amsterdam in 2013, Hubs was acquired by Protolabs in January 2021. To date, Hubs has produced more than 7 million parts, using various manufacturing technologies, including CNC machining, 3D printing and sheet metal fabrication.

For report enquiries, please contact press@hubs.com.

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