

Market Guide for 3D Printer Manufacturers

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Initiatives: [Manufacturing IT Optimization and Modernization](#)

Adoption of 3D printers by manufacturing organizations includes IT considerations, which are integral to their capability assessment. CIOs must understand the various 3D printer vendors' offerings in order to implement the right printing technologies and prepare IT systems to support new processes.

Overview

Key Findings

- 3D printing — or additive manufacturing — is not one singular technology, but comprises seven different core printer technologies.
- Enterprise-class 3D printer manufacturers have grown significantly in the past five years and are witnessing increased investment and funding aimed toward offering larger printer build areas, material innovation — especially polymers and metals — and faster print production.
- 3D printer manufacturers are partnering with resellers, material companies, software partners, business service providers and end customers to form a composable business and offer end-to-end 3D printing solutions.
- Most manufacturers do not articulate the potential impact of 3D printer use on either intellectual property protection or information technology.

Recommendations

CIOs responsible for manufacturing IT optimization and modernization must:

- Investigate the potential of 3D printing to support a transformation into a more composable, resilient business by bringing about agility and innovation, especially in supply chain disruptions triggered by the pandemic.

- Begin with the end in mind and invest in pilots to determine when, where and how to use 3D printing in the enterprise — start with decentralized production of low-volume or customized products.
- Collaborate with engineering, operations, supply chain and finance management to evaluate 3D printing opportunities and clearly articulate and communicate the role that IT plays in scaling end-to-end-solutions.
- Address potential intellectual property and cybersecurity issues by enabling enterprise architects to determine 3D printer software and workflow best practices from other users.

Market Definition

3D printing (3DP) is an additive manufacturing technique that uses a device to create physical objects from digital models. The output is a physical item such as:

- A prototype
- A tool, jig or fixture used in a manufacturing process
- An intermediate product or a finished product (including spare parts)

The 3D printer manufacturer market comprises technology and service providers offering 3DP hardware; designing, scanning and workflow management software applications; materials and supplies; and professional services, including presale and postsale, for use by public and private enterprises.

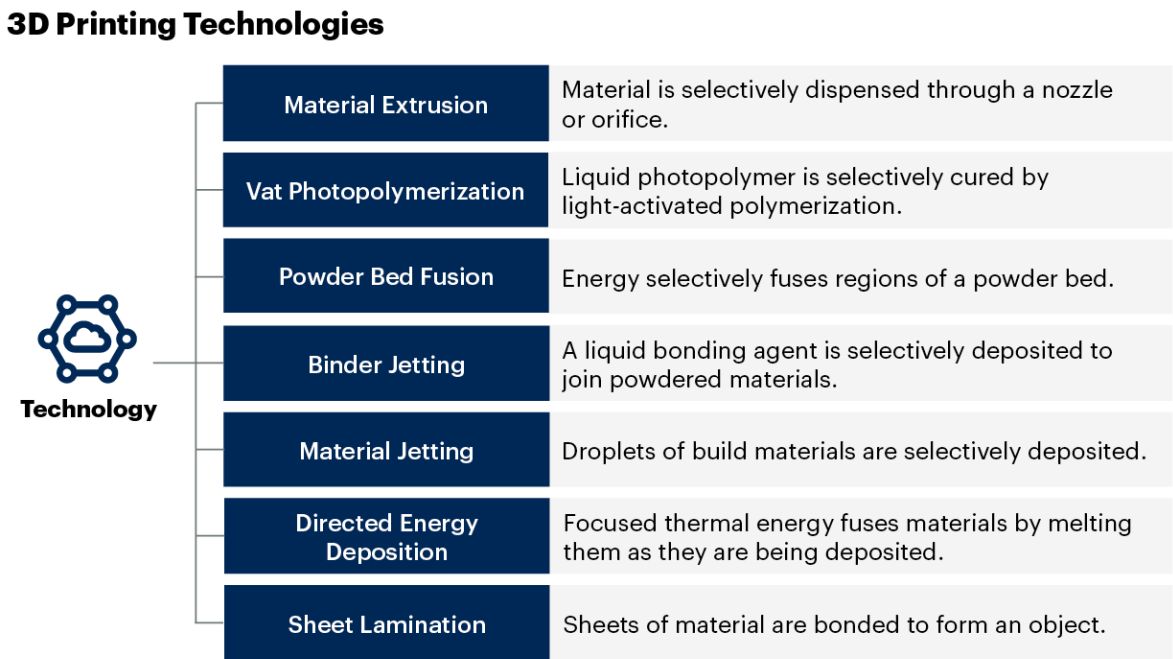
3D-printed materials usage includes plastics, ceramics, glass, composites, polymers, biomaterials and metals. 3D-printed output often requires postprocessing treatment such as machining or blasting to get the desired finish or precision.

This Market Guide covers providers of enterprise-class 3D printers, which operate on a global level and offer printers with a sales price above \$5,000.

Market Description

3DP comprises seven different printer technologies that currently constitute the 3D printer market, as found in our [Hype Cycle for 3D Printing, 2019](#). The most expensive 3D printers cost several million dollars, excluding installation costs that can add a substantial amount to the total investment, depending on the technology (see Figure 1). However, with the evolving 3DP market, the cost of buying and installing printers is declining. ¹

Figure 1: 3D Printing Technologies



Source: Gartner
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When selecting 3D printers and solutions, internal stakeholder collaboration and investment sponsorship can vary by organization. Engineering and operations managers typically make the final decisions on investments in new and existing manufacturing processes. Supply chain professionals deliver necessary supplies from partners and, if selected, coordinate deliveries from 3D print service bureau partners. CIOs and IT leaders ascertain, provide for and support the resulting information technology requirements (see [The Manufacturing CIO’s Role in Adopting and Scaling 3D Printing](#)). These efforts include support for file creation, distribution and manufacturing by providing information and software applications and their integration into the existing system landscape, as required by 3D printers and related workflow applications.

Market Direction

The pandemic negatively impacted the enterprise 3D printer market due to low equipment sales for 3D printer manufacturers.² However, the demand for 3DP is being supported by service bureaus and printer manufacturers offering on-demand production. These service bureaus continue to assist manufacturing organizations in building capabilities to overcome supply chain disruption and assist in decentralized production.

3D printer manufacturers are adding 3DP services and processes to their mix of existing products, minimizing the cost and risk of setting up an in-house operation (see [Market Guide for 3D Print Service Bureaus](#)). As service bureaus develop more capabilities, the concept of “local production for local consumption,” will gain more traction. Production that had been done in large factories, where the product was shipped overseas for use, is more likely to be produced locally. Some of the production may be done in microfactories that utilize 3DP, driven by low capital investment, as compared to major factories.

Amid the transforming 3DP environment, there have been increased corporate investments in the provider market. Over the last two years, the market has witnessed numerous acquisitions, investments, public offerings and partnerships. While printer manufacturers such as Desktop Metal and Stratasys have acquired entities to expand their printer portfolio, some organizations such as Markforged and Velo3D aim to go public by the end of 2021. These initiatives by printer manufacturers will continue to be focused toward inorganic business growth and enhancement of their 3DP capabilities, such as designing, postprocessing and quality assurance.

Automotive, healthcare, and aerospace and defense industry verticals will continue to drive the adoption of the technology, and will be supplemented by new areas of development such as electronics, consumer products and construction. Through the adoption of 3DP, organizations across various manufacturing verticals will develop business capabilities to overcome the challenges of traditional manufacturing and the pandemic (see Figure 2).

Figure 2: 3DP-Enabled Business Capabilities

3DP-Enabled Business Capabilities

Source: Gartner
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Gartner**Market Analysis**

The key to understanding the adoption of 3DP is to follow a structured approach and answer questions related to the end objective, as the answer to the first question will help in answering subsequent questions. The primary point of focus is on the part or item that you want to produce while trying to balance product innovation and business resiliency. The characteristics of the parts that you want to make dictate the 3DP technologies that can produce the part. This would be followed by the material that is leveraged for the necessary capabilities.

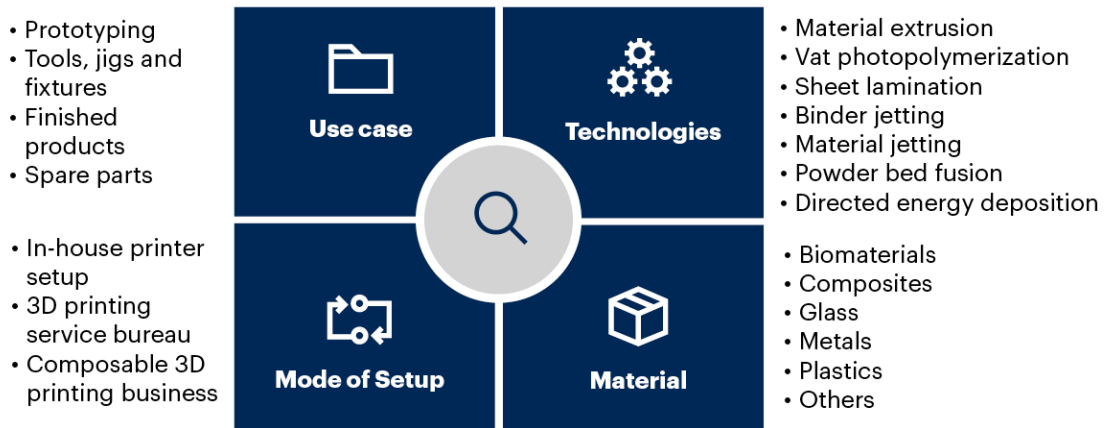
Subsequently, identify who manufactures the product, whether through an in-house 3D printer setup or 3DP service bureau, or a composable 3DP business (see [Innovation Insight for Composable Business for Manufacturers](#)).

A composable business is an organization that delivers business outcomes and adapts to the pace of business change by adopting composable thinking, a composable business architecture and composable technologies.

A synopsis of the insights for use cases, different technologies, materials and mode of 3D printer setup is as follows (see Figure 3).

Figure 3: 3DP Market Insights

3D Printing Market Insights



Source: Gartner
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Gartner

Use cases: 3DP can be used at all stages of the product development and production processes. Management must determine where to use 3DP — rapid product development, tooling, jigs and fixtures used in conventional manufacturing and assembly, intermediate products and samples, or finished goods sold to others. 3DP can also be used to reverse engineer products, which are no longer produced by manufacturers, on a low-volume scale.

Technologies:

- **Material extrusion:** This technology is primarily considered as the governing 3DP technology (by the public) as it is the most widely adopted one. The introduction of material extrusion printers that use bound materials is accelerating the development of 3D printed metal items. Additionally, high-temperature extrusion processes now can produce parts with highly resistant thermoplastic materials.
- **Vat photopolymerization:** This technology's devices can produce complex, finely detailed parts that are used in the audiology, dental, footwear, jewelry and movie industries, among others. While the parts produced are of high accuracy, their structural properties are compromised as there is no need for structural support. Hence the technology would be suitable for designers, engineers and others who are involved in prototyping, product development and redesign.
- **Powder bed fusion:** Powder bed fusion technologies use either thermal energy, lasers or electron beams to fuse a powder into shape. The materials can be plastic, metal, or other compounds. There is an increasing demand for laser-based powder bed fusion printers (primarily selective laser sintering) owing to the range of materials that are available for printing. ³ However, the technology does face challenges, owing to the need for support structures such as higher postprocessing tasks.
- **Binder jetting:** Binder jetting allows high-speed part production as there is no support structure required. This helps in maximizing the number of parts produced per build cycle, thereby reducing per-part costs. The technology is suited to large area prints with adequate surface detail, good tolerances and finish, when used with fine powders. However, most applications require some form of postprocessing to make the parts usable.
- **Material jetting:** Material jetting printers often use multiple printheads, enabling multiple materials with different mechanical properties and colors to be jetted in one pass (either through a continuous or a drop-on-demand approach). These printers print products with high accuracy and low waste; however, the adoption is constrained by the limited number of materials that can be used as droplets.
- **Directed energy deposition:** Directed energy deposition works only with metals, and is best suited to perform repairs on damaged products and for adding features to existing items. The imaging head, which combines laser and powder jetting nozzles, is found on hybrid and dedicated three-, four- and five-axis motion computer numerical control (CNC) machines and robotic arms.

- **Sheet lamination:** With limited vendors offering these printers, the sheet lamination market is trifurcated — one company laminates paper, one ultrasonically welds metals and one compresses sheets impregnated with plastic. The technology has experienced minimal adoption by end users to date (primarily for display models or for prototyping), owing to limited material usage and high postprocessing requirements.

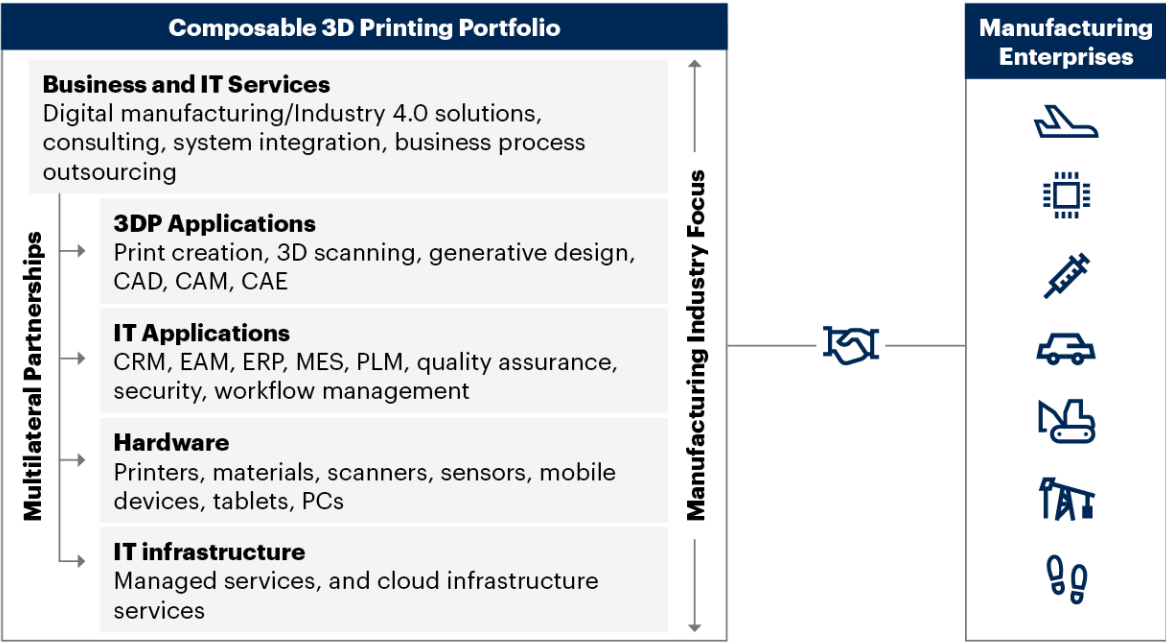
Materials: Polymers and metals are the most used materials in the 3DP market. The range of 3D printable plastics, composites and metals continues to expand, driven by involvement of chemical companies such as BASF Group, Royal DSM, Evonik and Henkel. 3D printer manufacturers will work with these material providers to create proprietary materials compatible with their printers. The [Senvol database](#) provides a comprehensive material list for every 3DP technology.

Mode of setup:

Traditionally, manufacturing organizations have been setting up their in-house printer operations, which has proven to be capital intensive on a high-volume scale. However, for low-volume manufacturing and experimentation purposes, 3D print service bureaus are proving to be a more efficient solution for organizations that either cannot or do not want to deploy their own 3D printer fleet. The shift of manufacturing organizations' preference toward service bureaus has led to the evolution of a new business model for both printer manufacturers and 3DP service bureaus — a composable 3DP business portfolio. These technology providers are now working together with resellers, material companies, software partners, business service providers and end customers to form an orchestrated assembly of packaged business capabilities to take advantage of each other's functionalities. Technology providers are forming multilateral partnerships with other organizations in the 3DP ecosystem to offer a packaged solution to companies across varied manufacturing industry verticals (see Figure 4). This will help manufacturing companies in enhancing their business resiliency by making them more agile and innovative.

Figure 4: Composable 3D Printing Business Portfolio

Composable Business Portfolio: 3D Printing



Source: Gartner
Note: CAD = computer-aided drafting; CAE = computer-aided engineering; CAM = computer-aided manufacturing; EAM = enterprise asset management ; MES = manufacturing execution system; PLM = product life cycle management
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Representative Vendors

The vendors listed in this Market Guide do not imply an exhaustive list. This section is intended to provide more understanding of the market and its offerings.

Market Introduction

Our list of profiled 3D vendors varies from year to year. The companies that follow are listed alphabetically and do not imply a rating or ranking. The vendors offer 3D printers for one or more technologies of 3DP summarized in Table 1. Additionally, the profile’s “industry focus” segment refers to the top markets the vendor caters to, and the vendor may be present in more markets.

Table 1: Representative Vendors Technology Snapshot

(Enlarged table in Appendix)

Vendor Name	Material Jetting	Binder Jetting	Material Extrusion	Powder Bed Fusion	VAT Photopolymerization
3D Systems	Yes	Yes	Yes	Yes	Yes
Additive Industries				Yes	
Carbon					Yes
Desktop Metal (including EnvisionTEC)		Yes	Yes		Yes
EOS GmbH Electro Optical Systems				Yes	
Essentium			Yes		
ExOne		Yes			
GE Additive		Yes		Yes	
HP Inc.		Yes		Yes	
Markforged			Yes		
SLM Solutions				Yes	
Stratasys	Yes		Yes	Yes	Yes
Velo3D				Yes	
voxeljet		Yes		Yes	
There are limited vendors offering directed energy deposition and sheet lamination technology-based printers; hence, we have not added these technologies to the table.					

Source: Gartner (August 2021)

We asked each vendor whether they provided certain presale and postsale services in addition to their 3D printer hardware and materials. Table 2 lists the offerings and denotes the vendors that provide them with an “X.”

Table 2: Selected 3D-Printing-Related Presale and Postsale Service Offerings
(Enlarged table in Appendix)

Vendor name	Presale services								Postsale services				Other services
	3D print production processes simulation	3DP of prospect's parts	Evaluation of potential impact on application design and engineering	Quality assurance of prospect's 3D printed parts	Evaluation of potential impact on IT creation, sharing, networking and archiving)	Evaluation of potential impact on intellectual property protection	ROI evaluation	Other consulting services	Marketing support (collateral materials, go-to-market advice, etc.)	Sales training	Operational training	Other consulting services	
3D Systems	X	X	X	X	X	X	X				X		X
Carbon	X	X	X	X			X		X	X	X	X	X
Desktop Metal (including EnvisionTEC)	X	X	X				X	X	X	X	X	X	
EOS GmbH Electro Optical Systems	X	X	X	X		X	X	X	X		X	X	X
HP Inc.		X	X	X				X	X			X	X
Markforged		X	X		X		X	X		X	X	X	X
Stratasys	X	X	X	X	X	X	X	X			X		X
voxeljet	X	X	X	X	X	X	X	X	X	X	X	X	X
Additive Industries, Essentium, ExOne, GE Additive, SLM Solutions and Velo3D declined to provide their list of pre- and postsale services in addition to their 3D printer hardware and materials. MES = manufacturing execution system													

Source: Gartner (August 2021)

Vendor Profiles

3D Systems

Rock Hill, South Carolina

Ownership: Public (NYSE: DDD)

Revenue from 3DP: Over \$500 million

www.3dsystems.com

Overview: 3D Systems provides comprehensive additive manufacturing solutions, comprising 3D printers, print materials and software. It offers multiple 3D printer technologies supplemented by its technical expertise and digital manufacturing workflow tools for manufacturing companies. 3D Systems' technology portfolio ranges from digitization, design and simulation through manufacturing, inspection and management.

Its proprietary software applications, 3D Sprint and 3DXpert, assist in the preparation and optimization of computer-aided design (CAD) data and management of the additive manufacturing workflow. The software provides capabilities such as automated build support and placement, build platform management and print queue management. The materials range includes plastic, nylon, metal, composite, elastomeric, wax, polymers and biocompatible capable materials, the majority of which are of a proprietary nature.

Technologies offered: Material extrusion, vat photopolymerization, binder jetting, material jetting, powder bed fusion

Materials leveraged for 3DP: Metals, hybrids, composites, plastics, biomaterials

Manufacturing facilities: Belgium, Germany, Netherlands, United States

Industry focus: Aerospace and defense, transportation and motorsports, semiconductor capital equipment, consumer products, healthcare (including bioprinting, medical devices and dental)

Additive Industries

Eindhoven, Netherlands

Ownership: Private

Revenue from 3DP: *Not disclosed*

www.additiveindustries.com

Overview: Additive Industries designs and manufactures industrial metal additive manufacturing systems. The company offers a modular powder bed fusion-based 3DP system, MetalFAB1, and an integrated information platform, Additive World Platform, to industrial markets. It also offers services such as printing on demand, application development and Scale4Series (assisting manufacturing organizations in building their complete 3DP manufacturing plant).

The MetalFAB1 system was designed from the ground up for series 3DP, from a small series of large parts (such as rocket engines) to large volumes of small parts (such as medical implants). Its current product model, MetalFAB-420, provides a build volume of 420 x 420 x 400 mm leveraging up to four lasers. The company announced the development of its new model MetalFAB-600 (offering a build volume of 600 x 600 x 1000 mm), which is expected to be available by the end of 2021. The Additive World Platform supports the 3D metal printing workflow through remote management, support for job preparation, machine and equipment monitoring, maintenance and analytics.

The company offers materials such as maraging or tool steel, aluminum, scalmalloy, titanium and nickel alloys to assist manufacturing firms printing metals through the laser beam, powder bed fusion printers.

Technologies offered: Powder bed fusion

Materials leveraged for 3DP: Metals

Manufacturing facilities: *Not disclosed*

Industry focus: Aerospace and defense, automotive, energy, manufacturing

Carbon

Redwood City, California

Ownership: Private

Revenue from 3DP: *Declined to answer*

www.carbon3d.com

Overview: Carbon designs and develops 3DP software, hardware, postprocessing solutions and offers education and training programs, as well as customer services. The industrial 3D printer manufacturer provides vat photopolymerization (Digital Light Synthesis) technology-based 3D printers. These printers leverage digital light projection and oxygen to produce products from a pool of plastic resin.

Carbon also offers 3DP software applications through a subscription-based model and provides software updates every six weeks. It introduced tools such as the Advanced Auto Supports tool to identify potential areas of failure in designs and the Part Serialization tool to track parts data and integrate with supply chain processes. The company also offers SpeedCell, a printer fleet management application, to install and manage multiple 3D printers. Further, the company's 3DP software and hardware are connected to the cloud via Amazon Web Services (AWS).

The company provides plastic materials such as rigid and flexible polyurethane, elastomeric polyurethane, cyanate esters, epoxies and urethane methacrylate to create products across a variety of industries, including automotive, consumer products, dental and medical.

Technologies offered: Vat photopolymerization

Materials leveraged for 3DP: Plastics

Manufacturing facilities: United States

Industry focus: Automotive, consumer products, dental, manufacturing, medical devices (implants, prostheses)

Desktop Metal

Burlington, Massachusetts

Ownership: Public (NYSE: DM)

Revenue from 3DP: Over \$10 million, but less than \$20 million (2020)

www.desktopmetal.com

Overview: Desktop Metal offers additive manufacturing solutions, globally, for engineers, designers and manufacturers. The company and its subsidiaries offer 3DP technologies such as material extrusion, vat photopolymerization (digital light processing and continuous digital light manufacturing) and binder jetting. In 2020, Desktop Metal began trading as a public company on the NYSE. The company's distribution network comprises over 200 resellers covering more than 60 countries around the world. Further, in 2021, the company acquired [EnvisionTEC](#), a 3D printer and resin manufacturer, to offer photopolymer 3DP solutions for end-use parts.

In order to offer its customers several price points depending on the desired features and applications, the company offers around 10 3DP platforms — Desktop Metal offers four platforms and the rest are offered by EnvisionTEC. Desktop Metal's Live Parts software autogenerates designs in real time, enhancing material and cost-efficiency, and design flexibility. Additionally, it is developing Live Sinter, a sintering process simulation software designed to improve part accuracy, reduce sintering support structures and associated costs.

The company's product portfolio supports 3DP with an array of materials, including metals, composites, polymers, sands, ceramics, biocompatible materials, woods and elastomers.

Technologies offered: Material extrusion, vat photopolymerization, binder jetting

Materials leveraged for 3DP: Biomaterials, composites, metals, plastics, others (such as sand, ceramics, wood and biocompatible materials)

Manufacturing facilities: United States

Industry focus: Automotive, consumer products, healthcare and dental, industrial manufacturing, aerospace and defense

EOS GmbH Electro Optical Systems

Krailling, Germany

Ownership: Private

Revenue from 3DP: Over \$100 million and less than \$500 million

www.eos.info/en

Overview: EOS provides additive manufacturing solutions for engineering, business, design and innovation applications. The company provides a platform-driven network of printers and offers a portfolio of processes, materials and services for the design and manufacture of metal and plastic products. The solutions are based on the powder bed fusion technologies – direct metal laser sintering (DMLS) for metals and selective laser sintering (SLS) for plastics.

EOS says it is creating an ecosystem of partners such as manufacturers, technology and material providers that assist the company in offering its systems, equipment and services for metal and polymer manufacturing. Further, it acquired Vulcan Labs in 2019 (a startup established by Stratasys), which is a research and innovation entity that assists it in developing its powder bed fusion technology for metal manufacturing.

EOS' current portfolio of materials comprises over 20 alloys for their DMLS systems including aluminum, copper, cobalt chrome, nickel-based, refractive metal, stainless steels, tool steels and titanium alloys. Additionally, the company also offers plastic materials such as polyamides, polystyrenes, thermoplastic elastomers, polypropylene and polyaryletherketone for their SLS systems. It partnered with KaJo Plastic to create a recovery circuit to recycle used plastic materials (currently through a program in Austria, Germany and Switzerland).

Technologies offered: Powder bed fusion

Materials leveraged for 3DP: Metals, plastics and biomaterials

Manufacturing facilities: Germany

Industry focus: Aerospace, automotive, consumer products, manufacturing, medical devices (implants, prostheses)

Essentium

Pflugerville, Texas

Ownership: Private

Revenue from 3D Printers: *Not disclosed*

www.essentium.com

Overview: Essentium manufactures and delivers industrial 3D printers and materials. The company offers high-speed material extrusion 3D printers and a broad portfolio of engineering-grade materials. It offers two lines of 3D printers; the High-Speed Extrusion (HSE) 180 3D Printing Platform enabling customers to print low-temperature, standard and high-temperature durable materials and the HSE 280i HT 3D Printer, which is an independent dual-extrusion 3D printer. Additional features on the HSE 280i HT 3D Printer include printing complex geometries with support materials, multimaterial printing and copy mode.

Essentium works with material providers such as BASF, Croda Smart Materials, LEHVOSS and Sabic, to offer industrial-grade materials to manufacturing organizations. These materials are designed and optimized for strength, mechanical performance, flexibility and the ability to withstand extreme environmental conditions.

Technologies offered: Material extrusion (high-speed)

Materials leveraged for 3DP: Composites and plastics

Manufacturing facilities: *Not disclosed*

Industry focus: Aerospace, automotive, consumer goods, contract manufacturing and biomedical

ExOne

North Huntingdon, Pennsylvania

Ownership: Public (Nasdaq: XONE)

Revenue from 3DP: Over \$50 million but less than \$100 million

www.exone.com

Overview: ExOne is an industrial 3DP system provider, which offers 3D printed products and services to manufacturing organizations. The ExOne 3DP process utilizes a binder jetting technology, which selectively jets binder onto a powdered material bed to produce parts with metal, silica sand or ceramic materials. Additionally, it also offers metal and sand parts on demand, and adoption services assisting manufacturing organizations with 3DP operations.

In 2021, ExOne partnered with Rapidia to offer The ExOne Metal Designlab, thereby enhancing its portfolio and technical capabilities. It offers Rapidia's technology that involves 3DP directly onto a mildly heated glass bed using a water-based metal or ceramic paste called HydroFuse, removing the need for the debinding step. ExOne also partnered with Xometry, an on-demand manufacturing service provider, to offer 3D metal printing services.

ExOne offers an array of powdered materials such as single-alloy metals, metal composites, ceramics and sand. Additionally, it also provides a portfolio of binders and activators for its printers. Furan, one of its binder materials, is made from renewable sources, such as corn husks, rice hulls, sugar cane and other biomaterials, enabling manufacturing firms to meet their sustainability goals.

Technologies offered: Binder jetting

Materials leveraged for 3DP: Metals, composites, others (sand)

Manufacturing facilities: Germany, Japan and United States

Industry focus: Aerospace and defense, automotive, industrial manufacturing, energy, healthcare

GE Additive

Munich, Germany

Ownership: Public (NYSE: GE)

Revenue from 3DP: *Not disclosed*

www.ge.com/additive

Overview: GE Additive, a subsidiary of General Electric, operates in the metal additive manufacturing market. It offers laser, electron-beam and binder-jetting-based 3DP systems, powdered metal materials and consulting services. Its consulting arm operates under the brand of AddWorks and helps customers and prospects with part design, material selection, business case development and industrialization of their additive manufacturing operations.

The company has built its product and service portfolio inorganically through establishing partnerships. Its acquisitions include Morris Technology (3DP service bureau), Arcam (powder bed fusion printer manufacturer that uses electron beam melting technology) and Concept Laser (powder bed fusion printer manufacturer that uses laser melting technology).

GE Additive, through its acquisition of Arcam, got access to AP&C, a powdered metal provider, which offers powdered titanium, aluminum and nickel alloys.

Technologies offered: Binder jetting, powder bed fusion

Materials leveraged for 3DP: Metal

Manufacturing facilities: *Not disclosed*

Industry focus: Aerospace, defense, manufacturing, automotive and healthcare (including medical and dental)

HP Inc.

Palo Alto, California

Ownership: Public (NYSE: HPQ)

Revenue from 3D Printers: Over \$500 million

<http://www.hp.com/go/3Dprinting>

Overview: HP's 3D printing and digital manufacturing printing segment offers a portfolio of additive manufacturing solutions and supplies in collaboration with an ecosystem of partners. HP offers its product and service portfolio of personal systems, printers and 3DP solutions through its 3D Solution Prepare, Care and Grow services.

The company's Multi Jet Fusion (powder bed fusion) technology came to market in 2016, and through a combination of speed, detail and flexibility, can be leveraged effectively for prototyping, manufacturing tools and production manufacturing. Further, as announced by HP, the company's Metal Jet (binder jetting) technology and Metal Jet Production Service will be available for commercial use by the end of 2021. This service enables customers to upload design files and receive industrial-grade 3D printed parts produced by HP's partners ATW (Parmatech) and GKN Powder Metallurgy.

HP is working with materials companies such as BASF, Henkel and Evonik with an aim to reduce materials costs and improve materials performance. Additionally, the company's 3DP business undertook initiatives in response to COVID-19 and leveraged Multi Jet Fusion technology to produce 3D printed parts for face shields, face masks and other items for hospitals.

Technologies offered: Binder jetting, powder bed fusion

Materials leveraged for 3DP: Metals, plastics

Manufacturing facilities: Singapore, Spain and United States

Industry focus: Automotive, consumer products, dental, healthcare, manufacturing

Markforged

Watertown, Massachusetts

Ownership: Private

Revenue from 3P: Over \$50 million, but less than \$100 million

<https://markforged.com>

Overview: Markforged, an industrial 3DP software and hardware provider, offers 3D printers to produce metal and composite fiber products. The company has a global distribution network with over 100 certified channel partners – in 2021, Philips became one of the company's printer distributors. The company, after the completion of its merger with one (NYSE: AONE), is expected to be listed on the New York Stock Exchange.

The company's 3D printer portfolio comprises metal printers, industrial and desktop composite printers, which can be monitored and controlled by a central platform, named the Digital Forge, individually. The printers are based on the material extrusion 3DP technology, which leverages the company's fleet management software to optimize workflows, provides predictive analytics, and connects, monitors and reports results across a fleet of connected printers. Additionally, the company also offers software solutions to augment the 3DP value chain – Eiger, a cloud-based fleet management solution and Blacksmith, an artificial-intelligence-driven adaptive manufacturing platform that connects part design, production and inspection.

Markforged offers over 14 proprietary materials and reinforcement fibers such as carbon fiber; fiberglass; high-strength, high-temperature fiberglass; and kevlar for its composite printers.

Technologies offered: Material extrusion

Materials leveraged for 3DP: Metals, composites, plastics

Manufacturing facilities: United States

Industry focus: Architecture, engineering and construction (AEC), aerospace and defense, automotive, manufacturing

SLM Solutions

Lübeck, Germany

Ownership: Public (XTRA: AM3D)

Revenue from 3DP: Over \$50 million, but less than \$100 million

www.slm-solutions.com

Overview: SLM Solutions provides metal-based additive manufacturing technology solutions in Germany and internationally. The company offers printers, software, material, quality assurance products and consulting services. It has its production facility only in Germany; however, its subsidiaries, based in Canada, China, France, India, Italy, Singapore, Russia and the U.S., promote local sales activities in their respective regions.

The company operates through two segments, machine business and after-sales business. The machine business segment engages in the development, production, marketing, and sale of machines and peripheral equipment for selective laser melting. There are four systems provided by the company (and the fifth one is expected to be available from 2022), which are differentiated by the size of the chamber and the number of lasers fitted. The after-sales business segment provides machine-related services and sells replacement parts, accessories, merchandise and consumables, as well as non-machine-related services.

In order to control the quality of the 3D printed products, SLM Solutions established a powder division in 2016 to supply customers with materials compatible with their selective laser melting machines. The company's metal powder portfolio comprises 16 specific alloys from six alloy families.

Technologies offered: Powder bed fusion

Materials leveraged for 3DP: Metals

Manufacturing facilities: Germany

Industry focus: Aerospace and defense, automotive, energy, healthcare, research and development

Stratasys

Eden Prairie, Minnesota, and Rehovot, Israel

Ownership: Public (Nasdaq: SSYS)

Revenue from 3DP: Over \$500 million

www.stratasys.com

Overview: Established over 30 years ago, Stratasys offers innovative 3DP solutions such as polymer 3D printers, polymer materials, software services, workflow integration and parts on demand. These solutions are leveraged by leading manufacturers, including many leading original equipment manufacturers, to improve product development time, product design and quality; to optimize supply chains and operations; and to reduce costs. The company's operations are supported by an ecosystem of materials and enterprise software providers and it has over 200 global channel partners.

Stratasys, with its recent acquisitions of RP Support and Origin and joint venture investment in Xaar 3D, has expanded its 3DP system offerings from material jetting and material extrusion to include vat photopolymerization and powder bed fusion technology-based printers. The company's other brands include: Stratasys Direct Manufacturing, which provides parts on demand; GrabCAD software and design community; Thingiverse.com, an online community for sharing downloadable 3D designs; and MakerBot, which provides desktop 3D printers.

The company also provides 3DP materials for both its material extrusion (fused deposition modeling) systems and its material jetting (PolyJet) systems.

Technologies offered: Material extrusion, vat photopolymerization, material jetting, powder bed fusion

Materials leveraged for 3DP: Composites, plastics

Manufacturing facilities: Israel and United States

Industry focus: Aerospace, automotive, dental, healthcare, manufacturing

Velo3D

Campbell, California

Ownership: Private

Revenue from 3DP: Over \$20 million, but less than \$50 million

www.velo3d.com

Overview: Velo3D, a powder bed fusion 3D printer manufacturer, develops and manufactures metal laser sintering printing machines, which are fully integrated with software toolsets for 3D print preparation, design and quality assurance, and real-time monitoring. The company's selective laser sintering (SLS) — direct metal laser melting, which uses only heat to melt material and not pressure — Sapphire line of printers are designed to enable support-free metal 3DP. Additionally, Velo3D plans to launch its Sapphire XC printer and Sapphire 1MZ, by the end of 2021. The company also cited that it would be listed on the New York Stock Exchange by the end of 2021. ⁴

The company provides end-to-end solutions by integrating its printers with software offerings: Flow, a simulation-driven print preparation software; and Assure, a quality assurance and control system. These software programs assist in direct CAD-to-print workflows, build simulations, machine health, automation, real-time monitoring and quality assurance, and the production of build reports.

Velo3D's printers use high-quality alloys with a high strength-to-mass ratio to ensure the printed products can withstand a high-temperature and corrosive atmosphere.

Technologies offered: Powder bed fusion

Materials leveraged for 3DP: Metals

Manufacturing facilities: United States

Industry focus: Aviation, energy, industrial manufacturing, space

voxeljet

Bavaria, Germany

Ownership: Public (Nasdaq: VJET)

Revenue from 3DP: Over \$20 million, but less than \$50 million

www.voxeljet.com

Overview: Voxeljet, an industrial 3DP system provider, offers high-speed, large-format 3D printers and on-demand parts services to industrial and commercial customers across the world. The company operates in two business segments, systems and services. The systems segment develops, manufactures, and sells 3D printers for prototyping and serial production. On the other hand, the services segment prints on-demand parts for its customers and provides casting services. It also creates parts, molds, cores and models using 3D CAD designs at its service centers worldwide.

Voxeljet sells its binder jetting and powder bed fusion technology-based 3D printers through its direct sales force and with the assistance of over 20 third-party sales agents globally. The company also offers refurbished 3DP systems, which are leasing returns, as a cost-effective alternative for manufacturing companies entering the 3DP market.

The company also offers consumables, including particulate materials and proprietary chemical binding agents, maintenance contracts, and spare parts. It provides materials ranging from sand and ceramics to plastic polymers such as polymethylmethacrylate, polyamide, polypropylene and thermoplastic polyurethane.

Technologies offered: Binder jetting, powder bed fusion

Materials leveraged for 3DP: Plastics and others (such as sand and ceramics)

Manufacturing facilities: China and Germany

Industry focus: Architecture, engineering and construction (AEC), aerospace, automotive, manufacturing, others

Market Recommendations

Enterprise 3DP is well along the path to mainstream adoption in most of the manufacturing industry verticals, which have manufacturing operations or supply chains. There has been an increasing number of 3D printer technology providers entering the market every year, yet some geographies are still underrepresented such as the Asia/Pacific region, indicating a high potential for growth.

CIOs and technology strategists should collaborate with their peers in engineering, manufacturing and marketing to assess the 3DP opportunity. The collaboration includes ascertaining, providing and supporting the 3DP's information technology requirements by assigning enterprise architects to monitor 3DP market developments and technology providers. Enterprise architects should visit other customers to learn IT implementation best practices based on their experiences implementing an enterprise-class 3D printer.

Traditionally, the adoption of 3DP has been done in silos, which has resulted in certain hurdles such as potential intellectual property (IP) and security issues, related to digital 3DP files. Additionally, there are limited IP protection services offered by 3D printer manufacturers. This poses a challenge, especially at a time when organizations are working toward creating decentralized production setups to achieve supply chain resiliency.

We advise clients to assess the benefits they can derive from adopting 3DP, whether it is across their manufacturing or supply chain setup, such as decentralized production, inventory reduction, mass customization or part consolidation. Clients should “begin with the end in mind,” and answer the following sequentially:

- What do you want to build?
- What technology or technologies can produce the part?
- Who manufactures the 3D printers that can build the part?
- Which 3D printer mode — or 3DP service bureau or composable business — meets your requirements?

Acronym Key and Glossary Terms

3D printing	An additive technique that uses a device to create physical objects from digital models. The term was coined in 1988 by MIT professor Ely Sachs, the inventor of binder jet printing, and came into widespread use in the early 2010s. “3D printing” is now synonymous with “additive manufacturing.”
Additive manufacturing	The ISO/ASTM 52900:2015(E) standard defines additive manufacturing as the “process of joining materials to make parts from 3D model data, usually layer upon layer.” The term has been supplanted by “3D printing” in the general and trade media, as well as in most businesses. The term “additive manufacturing” is still preferred by many engineers and others who do not believe the seven technologies are “printing” in the paper printing sense.
Advanced manufacturing	This is the application of digital technologies, platforms and ecosystems to modernize and extend traditional manufacturing value chains. Advanced manufacturing delivers higher levels of scalability, agility, flexibility and efficiency.
CAD	Computer-aided design
CNC machining	From Thomas, “CNC machining is a process used in the manufacturing sector that involves the use of computers to control machine tools. Tools that can be controlled in this manner include lathes, mills, routers and grinders. The CNC in CNC machining stands for computer numerical control.”

Evidence

¹ [The Evolution of 3D Printing](#), Thomas.

² [Wohlers Report: 3D Printing Industry Grew 7.5% in 2020](#), 3DPrint.com.

³ [3D Printing Market – Growth, Trends, COVID-19 Impact, and Forecasts \(2021 - 2026\)](#), Mordor Intelligence.

⁴ [VELO3D, a Leader in the Rapidly Growing, High Value Metal Additive Manufacturing Market, to Become Public Company](#), Velo3D.

Note 1: Representative Vendor Selection

Our list of representative 3D printer providers varies from year to year. This year, we retained 3D Systems, Desktop Metal (EnvisionTEC), GE Additive, HP Inc. and Stratasys from our previous Market Guide publication. We removed BeAM, while profiling Additive Industries, Carbon, EOS GmbH Electro Optical Systems, Essentium, ExOne, Markforged, SLM Solutions, Velo3D and voxeljet. The mix reflects manufacturers of different 3DP technologies that are at the forefront of industry efforts to bring production equipment to the market.

Note 2: Gartner's Initial Market Coverage

This Market Guide provides Gartner's initial coverage of the market and focuses on the market definition, rationale for the market and market dynamics.

Document Revision History

[Market Guide for 3D Printer Manufacturers - 24 January 2019](#)

[Market Guide for 3D Printer Manufacturers - 11 December 2017](#)

[Market Guide for 3D Printer Manufacturers, 2016 - 24 October 2016](#)

[Market Guide for 3D Printing - 3 December 2014](#)

Recommended by the Authors

Some documents may not be available as part of your current Gartner subscription.

[The Manufacturing CIO's Role in Adopting and Scaling 3D Printing](#)

[The IT Impact of 3D Printing on Business Models](#)

[Hype Cycle for 3D Printing, 2019](#)

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Table 1: Representative Vendors Technology Snapshot

Vendor Name	Material Jetting	Binder Jetting	Material Extrusion	Powder Bed Fusion	VAT Photopolymerization
3D Systems	Yes	Yes	Yes	Yes	Yes
Additive Industries				Yes	
Carbon					Yes
Desktop Metal (including EnvisionTEC)		Yes	Yes		Yes
EOS GmbH Electro Optical Systems				Yes	
Essentium			Yes		
ExOne		Yes			
GE Additive		Yes		Yes	
HP Inc.		Yes		Yes	
Markforged			Yes		
SLM Solutions				Yes	
Stratasys	Yes		Yes	Yes	Yes
Velo3D				Yes	

voxeljet

Yes

Yes

There are limited vendors offering directed energy deposition and sheet lamination technology-based printers; hence, we have not added these technologies to the table.

Source: Gartner (August 2021)

Table 2: Selected 3D-Printing-Related Presale and Postsale Service Offerings

Vendor name	Presale services							Postsale services					Other services
	3D print production process simulation	3DP of prospect's parts	Evaluation of potential impact on application design and engineering	Quality assurance testing of prospect's 3D printed parts	Evaluation of potential impact on IT (file creation, sharing, networking and archiving)	Evaluation of potential impact on intellectual property protection	ROI evaluation	Other consulting services	Marketing support (collateral materials, go-to-market advice, etc.)	Sales training	Operator training	Other consulting services	Creation of an ecosystem/workflow (such as designing software and ERP/MES integration)
3D Systems	X	X	X	X	X	X	X				X		X
Carbon	X	X	X	X			X		X	X	X	X	X
Desktop Metal (including Envision TEC)	X	X	X				X	X	X	X	X	X	

EOS GmbH Electro Optical Systems	X	X	X	X		X	X	X	X		X	X	X
HP Inc.		X	X	X				X	X			X	X
Markforged		X	X		X		X	X		X	X	X	X
Stratasys	X	X	X	X	X	X	X	X			X		X
voxeljet	X	X	X	X	X	X	X	X	X	X	X	X	X
Additive Industries, Essentium, ExOne, GE Additive, SLM Solutions and Velo3D declined to provide their list of pre- and postsale services in addition to their 3D printer hardware and materials.MES = manufacturing execution system													

Source: Gartner (August 2021)